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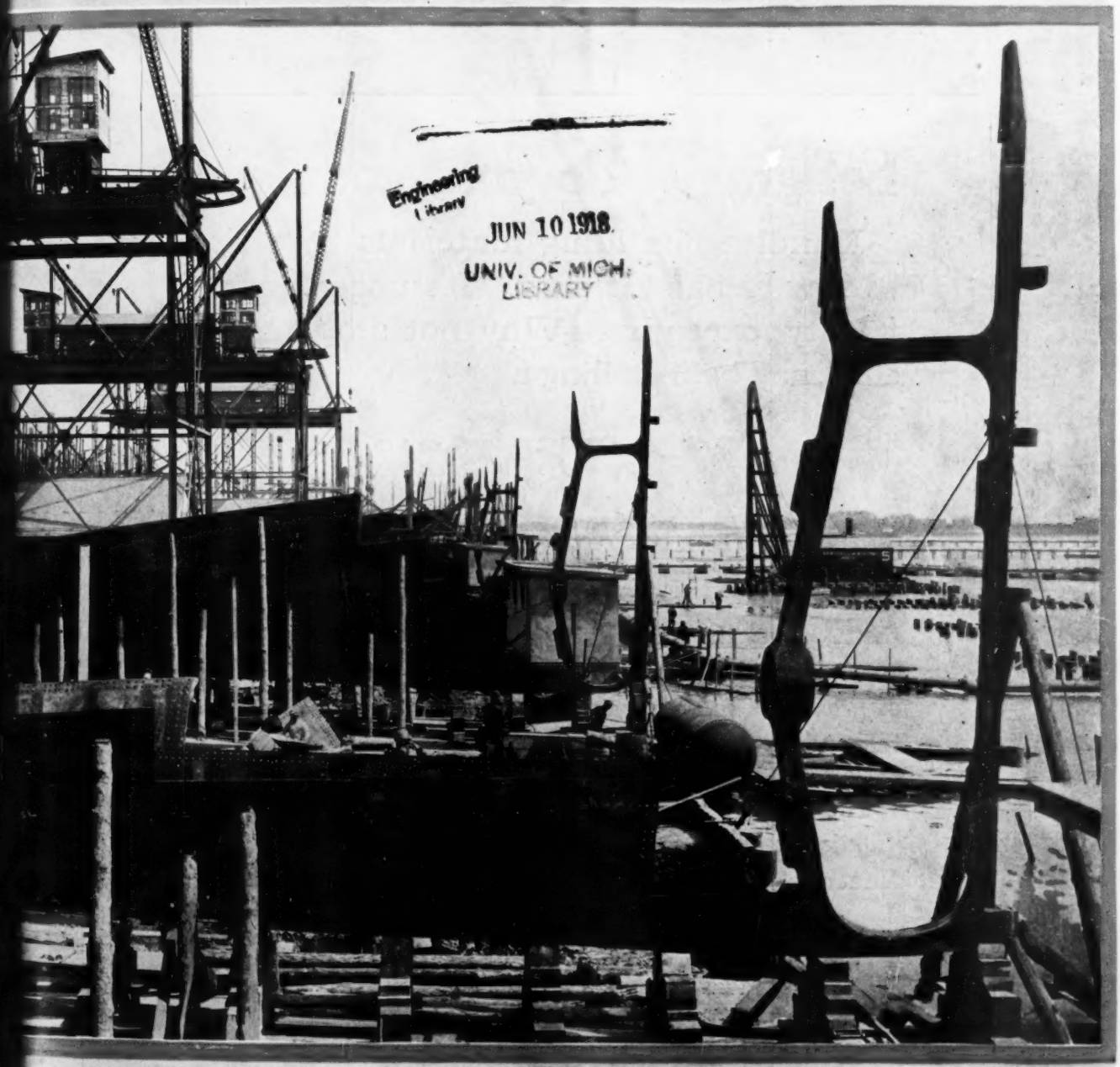

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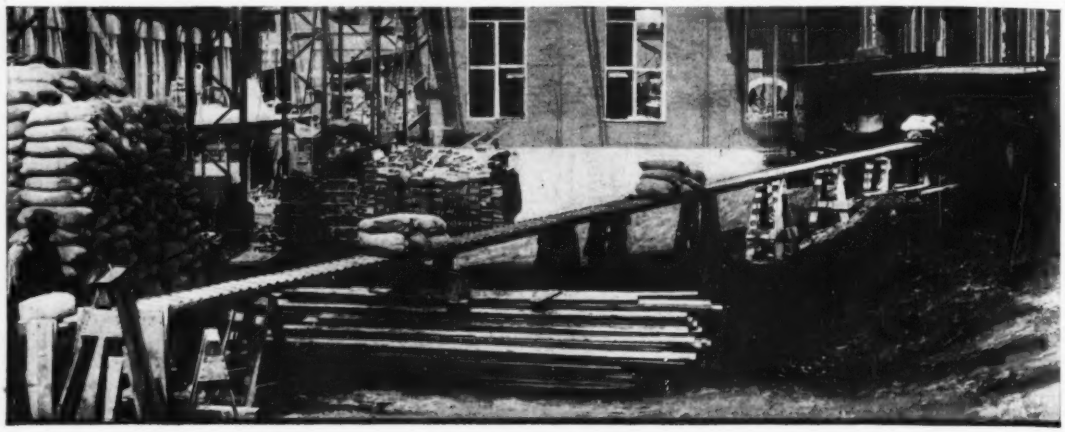
Effect of Strain on the Structure of Steel
By HENRY J. PRICHARD

Ship Erection Equipment at the Newark Bay Yard of the Submarine Boat Corporation

Municipal Improvements in Russia
By STERLING H. BUNNELL



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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor* — CHARLES WHITING BAKER, *Consulting Editor*

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Conserving Industrial Man Power

OUR progress in the war, though it is not to be belittled, has been slow in many directions. Week before last came the encouraging word that the Provost Marshal General would force into useful occupations or into the ranks all idlers and those engaged in work that could be just as well performed by women or the physically unfit. Last week came the equally cheering news that the light that broke on England two years ago has now broken here, and that men vitally needed in the industries can be furloughed back from the army to their occupations. It should not have been difficult to understand the absurdity of putting into the army for training as a common soldier or a mule skinner—occupations that can be learned in a few months—toolmakers who have spent five or more years in learning their business. Yet with England's example before us, with sure evidence—convincing even to the civilian—that this war was to be won more through engineering and industrial achievement than through flesh and blood, the military authorities sent into the camps men virtually indispensable to industry. One man of our acquaintance, an expert toolmaker, is now a mule driver, while the munitions industries of the country are frantically looking for men of his attainments. Progress is slow in some directions, but we are surely getting the right point of view with reference to the war and its needs.

Scope of Inquiry Into Reconstruction

RECONSTRUCTION is a word not infrequently heard where men gather to discuss the effects of the war. It is less often heard here than in England, where the Ministry of Reconstruction has scores of committees working on the problems that will be found in the wake of the war. It is none too soon to start now on our studies. For that reason there appeared in last week's issue of *Engineering News-Record* the first of a number of articles on the character of inquiry needed. The second article will be found in this issue. As to the scope of the studies, one thing stands out very clearly—that it must be very broad. The war has not only created a set of conditions that modify profoundly the former currents of our national life, but has quickened all our thinking. The many changes needed to meet urgent war needs have made us adaptable mentally, so that now overnight we divest ourselves of prejudices that previously only decades could change. Our thought processes being accelerated, our attitude toward new ideas being receptive, the opportunity is afforded for readjustment in every phase of our national life. Manifestly, the opportunity should be grasped. The inquiry must be wide. It must embrace every factor with large bearing upon the common welfare. Evidently, the scope requires a commission with a broad representation. This is the nub of Mr. Bathon's suggestion.

The Engineer and Reconstruction

FOR the engineer a study of reconstruction offers an especially inviting vista. More and more, scientific methods are being applied to every phase of our political and social life. They must be even more generally used if we are to solve rightly not only the difficult problems that faced us as a nation before the war, but also those thrust upon us by the world conflict. The recognition is clearer today than ever that industry and business are the determinative factors in our political and social systems. In them and through them the country lives, prospers, stands still or declines. Yet their relationship to the public weal is only indifferently understood, and our mass dealings with business have been marked by an empiricism that instead of making the business system serve the common good has resulted in the wrecking of parts of the system, and the strangulation of others. Witness the present condition of the railroads and the recent merger of the four leading express companies. If we are to handle the business organization more successfully in future scientific methods must replace the empiricism of the past.

Swift Action on the Overman Bill

NO TIME was lost by the President in availing himself of the broad powers conferred by the Overman law for centralizing in experienced hands the control of war production. The manufacture of aircraft was divorced from the army machine and placed, on the day the bill became law, in the hands of men familiar with such tasks. Last week a further step in the same direction vested more definite authority in the War Industries Board, and made it responsible to the President alone. These changes come none too soon. They forecast what we have so seriously needed—a free hand for the engineer, the man who knows how. There must be no more neglecting of research, manu-

facturing and construction facilities, in which our greatest resources have not yet been tapped. Improved appliances of war must be adopted and produced in quantity as fast as they prove useful. Meanwhile, production of what we know to be available must not halt because someone thinks improvements may be forthcoming at a future date. The work of reorganization must go on until those able to bring our full capacity to bear on the war are set free alike from political interference and from the control of outgrown ideas.

Legal, Moral or Engineering?

AGAIN the engineer has successfully invaded the sacred domain of the lawyer. This time the issue was a moral one—or the lawyers thought it was. In the case against the Lockport Light, Heat & Power Company for lower rates the city tried to set aside the allowance for overhead made by the city's engineer. Said counsel, "As the question whether overheads should be included . . . is a legal or moral question as applied to the facts of this case, rather than an engineering question, the fact that Mr. B—— has allowed a substantial item for such overheads should not militate against our contention that no allowance therefor should be made. He is an engineer, not a lawyer, and he naturally treated the subject from an engineering, not from a legal or moral standpoint." The comment of the New York Public Service Commission, Second District, on this point, as quoted in *Public Utilities Reports*, is brief: "The question of overheads is neither moral nor legal, but one of fact, and they are actual and real. The city employed Mr. B—— as its engineer, and we believe it should be bound by the evidence he gave in respect to overheads." Evidently, the engineering standpoint is not necessarily illegal or immoral.

Standardizing Wages for Common Labor

SENSELESS bidding of employers against one another for labor, both common and skilled, has been responsible for much of the industrial disturbance. Part of the difficulty will be done away with if employers generally will call upon the United States Employment Service to fill their needs. Full relief, however, cannot be expected until standardization of wages is brought about. This surely is coming. It is publicly known that the Department of Labor proposes to fix the wages of common labor. This, however, will be only a first step, and ultimately all the large groups of labor employed on war contract work will be drawing standardized wages, which without doubt, will be adjusted in accordance with the fluctuation in the cost of living. While we cannot look with equanimity upon this extension of Government control, it is apparently essential under war conditions. Instead of opposing such plans, therefore, it is well for employers to fall in with the Government's work. These are days for sacrifice and coördination for the public good rather than for the maintenance of views sound in peace times but incompatible with war conditions.

Fabricated Steel Ships Enter the Shipbuilding Drive

INTENSIVE production of ships reached a new stage when the "Agawam" was launched at Newark Bay last week. The event marks an epoch. The great bulk-order yards of the Emergency Fleet Corporation have started to produce ships.

Quantity production of ships as developed by these yards means the application of factory methods, standardization and division of functions; it means the fabricated ship. A year ago this was nothing more than a dream, but on the dream were founded the agency yards. It has become a reality, a tangible fact.

As the mere addition of one more vessel to our supply fleet the "Agawam's" entrance into the water is of only momentary interest. But it is memorable as an event signalizing the success of a new conception: that of using existing shops, though far inland, to take the place of shipyard shops that we lack. This simple idea created the fabricated ship, which is not a new kind of ship, nor even a new design—for the design, apart from modifications in detail that sweep away many of the traditional peculiarities with which the shipbuilding art is encumbered, is that of the conventional ship—but the result of a new method of production.

The simple idea has had a remarkably far-reaching effect. Through it the entire bridge-building industry has been drafted into shipyard service. Well over a hundred steel-fabricating shops scattered over the land are working on ships, a noteworthy contribution to the great war problem of utilizing every pair of hands in the country for behind-the-lines work. The great labor and equipment resources of these shops have brought into action a virtually limitless reserve of shipbuilding capacity. Today shipbuilding is the occupation of inland cities as well as of coast towns.

It was a civil-engineering industry that supplied the great reserve of labor, technical ability and equipment needed for emergency shipbuilding. Of this the profession may justly feel proud. For, had that industry been less thoroughly developed, less highly organized, it would not have been ready to take up the new service.

There is cause for equal gratification in the excellence of the results. Predictions have been made that endless trouble would be experienced from the failure of parts to fit at the ways, due to inherent unsuitability of bridge fabricating and erecting methods to the highly specialized ship work. It was asserted that the processes of making straight members for bridges and buildings would be found inadequate for shaping and fitting the intricately curved and beveled pieces of which a ship is built. No doubt there was opportunity for such troubles to develop; but the facts show that they have been avoided. The ships are going together well. Structural designers and shop men have proved equal to solving the new problems put before them. Faith in the possibilities of bridge-shop fabrication and shipyard assembly is vindicated.

That the Newark Bay yard should have the distinction of this pioneer performance is eminently fitting. The men who built that yard were the ones who had the vision of turning out ships in large number by the expedient of enlisting non-shipbuilding industry in

the work. And it was their strength of conviction, also, that secured the Government's acceptance of the idea. Rightly, then, it was for their yard to put into the water the first vessel representing the idea in steel.

The working tools used for ship erection at the Submarine Corporation's yard, described on page 1072 of this issue, give evidence of the original thought which has been applied to the emergency shipbuilding program. The same bold courage in attacking new problems in new ways is apparent in the methods and equipment of the other large yards. The best genius of structural engineering has been joined with that of shipbuilding in preparing for the huge task.

Half a million tons cargo capacity is now on the ways of the Fleet Corporation's agency yards, and altogether probably a million tons of fabricated steel vessels are under construction. The enormous shipbuilding machine which has been created is already in successful operation. In a few months this vast fleet will be on the ocean, its place on the ways taken by steel for more ships. Daily launchings soon will signalize the final realization of quantity production.

Government Partnership in the Express Business

GOVERNMENT participation in the profit of the express companies, provided the profit exceeds 5% on a capitalization of $30,000,000, introduces into our Federal relationship with business a plan which has had considerable success in the operation of local utilities. In Chicago, Kansas City and elsewhere the street railway systems are operated under a partnership by which the municipality shares in the net profits. That form of contract has been successful. It gives Government sanction to the existence and continuance of the private corporation, retains the incentive of private gain, but prevents franchise privileges from being made the means of the acquisition of disproportionate private profits.

This partnership is the chief item of interest at present in connection with the merger of the four leading express companies into one organization. There probably will be other interesting features when all of the facts regarding the merger are made public. For example, it is understood that in determining the new capitalization the Government gave consideration only to the value of that part of the physical assets used in the express business. No inquiry was made into development expense, nor was consideration given to the loss that might be incurred by stockholders because the capitalization was reduced and a practically fixed return set upon this reduced capitalization. The effect of this procedure upon total dividends is, of course, the same as the reduction in express rates made some years ago. Nevertheless, the disregarding of all elements of value save the physical assets marks another interesting step in the relations between Governmental authority and public-service corporations.

The case, of course, would be still more interesting if it were clear cut and not complicated by such matters as declining earning power and the evident desire of the express companies to find some way out of the difficulties which they were facing. In fact, from the standpoint of market value the companies probably got all they expected.

As the matter stands, therefore, the most interesting feature of the merger is the arrangement by which the Government becomes a participant in net earnings provided they exceed 5% on the $30,000,000 capital allowed. It offers food for thought in connection with the possibility of the railroads reverting to the control of their owners after the war.

State Management of Boston's Street Railways

IN CITY after city the problem of street railway service is being wrestled with. Those who are giving it most careful study generally agree that the era of uncontrolled private operation is passing into history—that some form of partnership or complete public ownership will result. There has been a steady evolution in these directions during the past dozen years and more; but the financial conditions resulting from the war have produced a crisis which will hasten developments. The enactment on May 22 of the law by which the State of Massachusetts is authorized to take charge of the Boston Elevated Railway system is the most remarkable step toward public control that has thus far been taken. Its results should help to determine for the near future what the relationship of the Government to public-utility enterprises will be.

The action in Boston is of special interest because Massachusetts led all the states in establishing effective public supervision of the operation of utilities, and in no state has such supervision been exercised more successfully, on the whole. The fact that Massachusetts now definitely abandons this system and places entire control of the Boston street railway network in the hands of state officials establishes an important precedent.

Perhaps the most remarkable feature of the Boston plan is the provision by which the public is obliged automatically to pay the cost of its street railway service. The entire street railway system owned and operated by the Boston Elevated Railway Co. is to be turned over to the management of five trustees to be appointed by the Governor. They will receive absolute authority to fix fares, without interference by any other state board or commission. They are required to fix such fares "as will reasonably insure sufficient income to meet the cost of the service, which shall include operating expenses, taxes, rentals, interest on all indebtedness, allowance for depreciation of property, and for obsolescence, losses in respect to property sold, stored or abandoned, all other expenditures and charges which may be properly chargeable against income or surplus, fixed dividends on all preferred stock of the company from time to time outstanding, dividends on the common stock of the company from time to time outstanding at the rate of 5% for two years, 5½% for the next two years, and 6% for the balance of public operation."

The framers of the law deserve great credit for including in its provisions a requirement which will end the tradition of the uniform five-cent fare. It obliges the trustees to fix a schedule of at least eight

different grades of fare, and one or more of these rates of fare are to be altered whenever the income of the system shall exceed or fall below the cost of service as above defined. In the taking over of the lines by the trustees, provision is made for the creation of a $1,000,000 reserve fund from the proceeds of a 7% preferred stock issue. Whenever this reserve fund exceeds or falls below the original amount by 30%, the trustees must make a change in the rates of fare. Provision is further made for the contingency that increases in rates of fare, authorized as above, might be insufficient to meet the cost of service. In that case, the amount of the deficiency must be made good by the state treasurer, who will assess the amount upon the various towns and cities in which the system operates.

A question of great interest in connection with taking over by the public of any utility is the provision for financing necessary extensions. One of the most serious problems of the street railway situation results from the fact that for a number of years street railway companies have halted extension work, and city transit facilities are deficient in consequence. One of the things which made action necessary at Boston was the imperative need of financing the extensions on which the company is already at work and whose completion is a public necessity. The act provides for a $2,000,000 fund to be raised by the company by an issue of 7% preferred stock before the state assumes control. For further use in the construction, lease or purchase of extensions the trustees have authority to issue the company's stocks and bonds, but must do so with the consent of the directors of the company. They may do so without such consent, however, in the case of the construction or purchase of surface railways, if they find public necessity and convenience require it.

Finally, the act provides that either the State or the Massachusetts cities concerned may take over the entire assets, property and franchises of the company by assuming its bonded and other indebtedness and paying the company cash equal to the amount paid by the stockholders for the stock then outstanding. This may be done at any time during the period of public control, or the property may be acquired at any time by the State or city through the exercise of the power of eminent domain.

The success of this experiment in the operation of a public utility will depend very largely on the character and ability of the trustees to be appointed by the Governor. In few cities of the United States have the street railways been managed with such a high degree of engineering and technical ability as in Boston. If the State trustees have the wisdom to retain and to continue in the service efficient operating managers in all departments, they will justify the hope of municipal ownership advocates. One means for securing efficiency and economy, though, they necessarily will lack, that of gain for private controlling interests. If, on the other hand, as has happened so frequently in Boston, political and personal preference is allowed to influence the selection by the trustees of the men who carry chief responsibility, the penalty for such mismanagement will be visited not on the company's stockholders, but on the residents and citizens of the cities which receive the street railway service. Since it is the voters who have it in their power to punish such misuse of public office, this must be accounted one of the chief merits of the Massachusetts law.

Contractors' Organizations Can Be Used to Advantage in France

MODERN warfare requires a tremendous amount of construction work. Some conception of the volume may be arrived at by considering the statement recently made by engineering representatives of our allies, that about 90 per cent. of the time of all the troops in Europe is occupied with construction work, and by remembering that the number of men in these armies runs high into the millions. It is evident, then, that our troops need construction ability, or, at least, experienced direction in construction work.

Out of a list of more than fourteen hundred contractors with the organization and equipment to undertake major work, the Government has so far made use of less than two hundred. This list, moreover, does not include all the large contracting firms, and leaves out most of the smaller organizations. Highway, railroad and building contractors with competent foremen and superintendents too old for the draft but with training that would be of inestimable value at the front, are numbered by the thousands. No plans for their use have been made, or at least announced, and normal work in their lines is decreasing daily. The contractors are going out of business, their men are being forced into occupations where their life training is of no value, and at the same time our allies tell us that we badly need these men behind the battle lines.

Many of these contractors have asked this journal what they should do with their forces. One such, with an organization for road work second to none on the Pacific coast, recently spent time in Washington going from department to bureau and from branch to division in a vain effort to find some way of utilizing his force, finally returning to California to close up his firm's affairs. Without doubt, his force could have replaced double their number of military men on French roads, with an increase of efficiency.

These organizations could be moved bodily to the battle front. There is no question of profit, of bidding for work, of retaining even the semblance of a money-getting organization. These groups have the experience and the executive ability to put construction work through. They should be graded and paid as are the military, but taken to France as organizations.

The grim business of "getting there fustest with the mostest men," as a picturesque Civil War leader defined the strategy of victory, has grown very complicated and has come to depend entirely on engineering construction. The rapidity and skill with which the Germans build their defense systems, the continuity and sufficiency of their transport when they are advancing, are eloquent witness to the fact that their construction leadership is of a high order. Our construction men, numbered by tens of thousands, have been acknowledged for half a century as the most efficient in the world. How soon are we to give them a chance to prove their worth against the enemy?

Tower Derricks Serve Twin Shipways at Submarine Boat Corporation Yard

Ships Erected by 86-Foot Booms on Fixed Towers Between Pairs of Ways—Two Booms Per Ship—Arrangement for Greatest Flexibility—Ships Overhang Narrow Ways and Scaffolds Are Built Up From Ground

HIGHLY individual features of the building-berth layout and the equipment for erecting ships are found at the Newark Bay yard of the Submarine Boat Corporation, one of the three first agency yards of the Government Emergency Fleet Corporation. The shipways are grouped in pairs, and tower derricks for handling the ship parts are set between the pairs only; they reach across one ship and lift material from a track in the middle of the pair. A large storage space is provided at the head of each pair of ways, permitting all the material for two ships to be stored on the ground before the keels are laid. There is no general storage yard for finished ship parts. In these features the Submarine Boat Corporation's erection layout is most radically different from those of the other large shipyards, but there are many further differences, and the plant throughout bears the impress of originality.

From the time when the corporation began its preliminary work, May, 1917, it studied ship construction as a new problem in structural-steel fabrication and field erection, on which shipyard traditions and precedent had little bearing. In particular, all matters affecting erection—the layout of building berths, the choice of machinery, and the detail equipment—were worked out by men whose experience had been in bridge and building construction exclusively.

Dependence on derricks for the erection work was the natural outcome of these conditions. In working out the application of the use of the derricks, flexibility of service was made the primary objective, to the end that maximum speed of erection might be realized in the ship construction.

The twin arrangement of the ways was conceived by B. L. Worden, general manager of the Corporation, as a means of economizing space along the yard front and of concentrating the derrick facilities in the most advantageous way. The average spacing of the shipways is 82 ft., an exceedingly compact grouping for ways laid out to take 9500-ton ships; several other yards building ships of this size have a spacing 50% larger

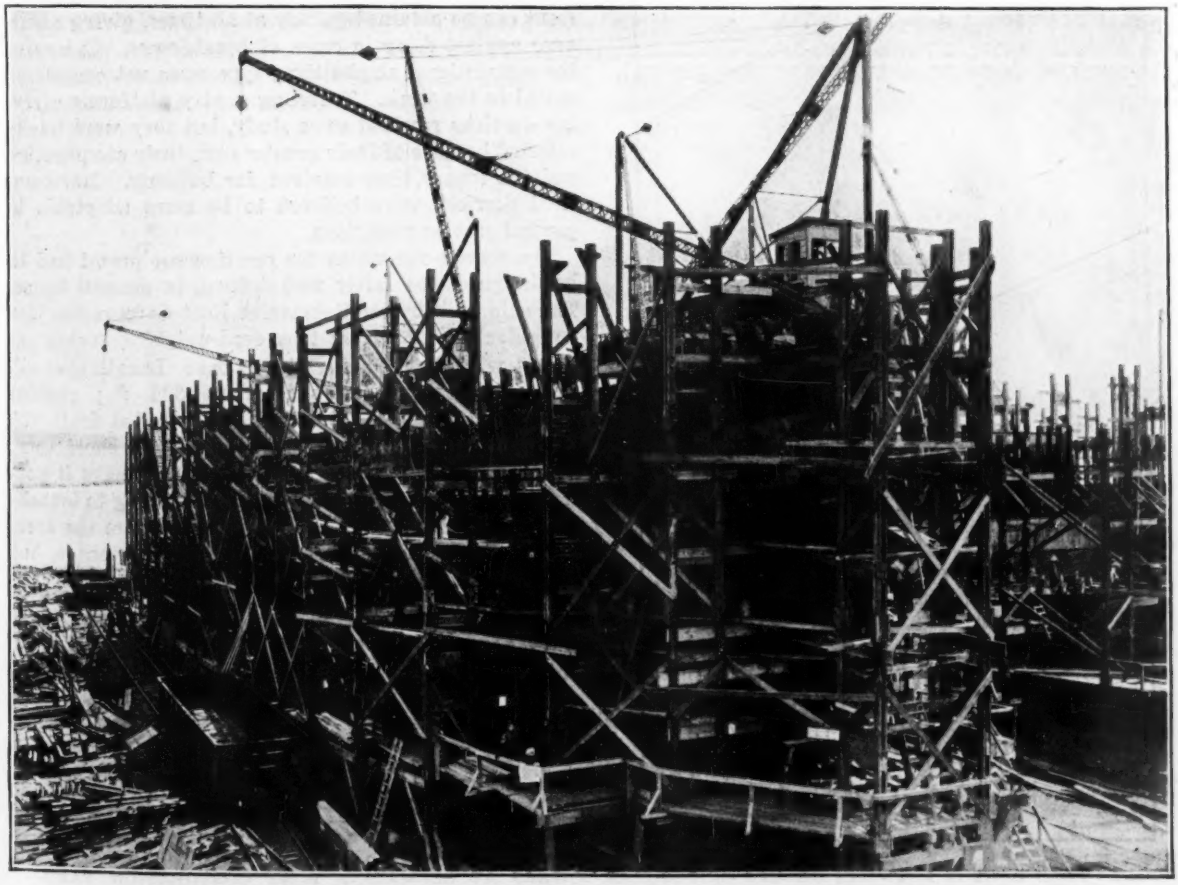
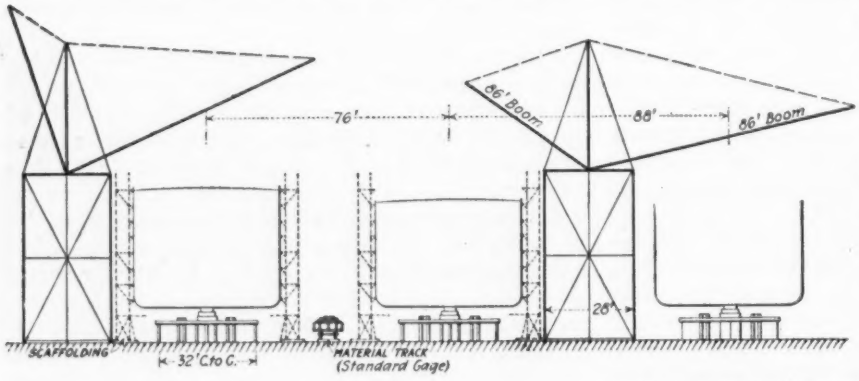


FIG. 1. SHIP ERECTION BY ELEVATED DERRICKS HOISTING FROM TRACK ON OPPOSITE SIDE OF SHIPWAY

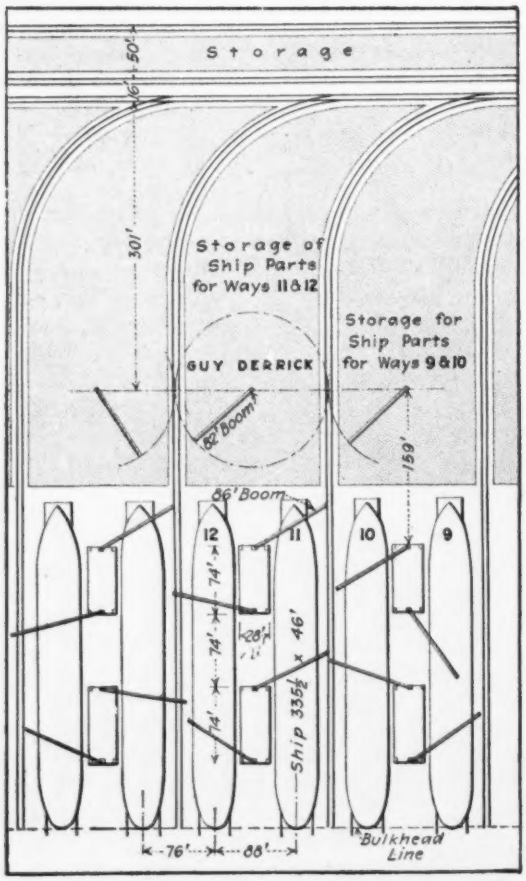
and therefore accommodate only two-thirds as many ways on the same frontage. The concentration of derrick facilities appears in the fact that though only two booms are provided per ship, four can work on any one vessel. Each of the four derricks in a group will work regularly on both of the adjoining ships. When one ship is at a stage of erection where it does not need full derrick service, the adjoining one can utilize the spare capacity. It is worth notice also that while there is only one railway-supply track for every two ships, each ship can be served from two different tracks, as every derrick boom is able to reach the track beyond either adjoining ship. The sketch plan of the ways, and transverse section, Fig. 2, brings out the relation of ways, derricks and track.

How the derricks cover the ship space is indicated in the sketch, Fig. 3. The storage yard at the head of the ways is served by a guy derrick of 82-ft. working radius, and by locomotive cranes with 50-ft. booms able to lift 1½ tons. Between pairs of ways are four stiffleg derricks carried on two steel towers. These, in conjunction with the guy derrick, can pass material from storage the full length of the ship, more than 500 ft., by transfer from hook to hook. Only surplus material is to go through storage, however, and so long as shop deliveries are coördinated properly with erection requirements, the material arriving by rail will go directly out on the way tracks and will be hoisted to place in the ship. The arrangement of the tower derricks, as will be seen by referring to Fig. 2, means that they will take their supply at practically full reach and thus will do most of their work with nearly horizontal booms.



The decision to use fixed hoisting devices was based on the belief that the derrick is the most adaptable tool for general erection use, as well as on the knowledge that derrick parts and equipment can be obtained quickly at all times, giving assurance against delay in cases of breakdowns. Cranes of the conventional shipbuilding type were not considered suited to the work. Traveling gantry platforms carrying derricks received some study, but they were finally rejected because of their greater cost, their complication and the longer time required for building. Moreover, fixed derricks were believed to be more adaptable to general service conditions.

The service for which the erection equipment had to be designed was fairly well defined, in general terms. The ship built by the Submarine Boat Corporation is a freighter of 5500 gross tons dead-weight carrying capacity, with the following dimensions: Length over all, 335½ ft.; between perpendiculars 324 ft.; molded breadth 46 ft.; molded depth 28½ ft.; loaded draft 22½ ft. The weight of the hull is about 1800 short tons. An erection speed was desired that would make it possible to build a ship complete from keel-laying to launching in less than 60 days. This would require the erection of more than 30 tons per day on the average, but the maximum rate of erection at some time during the



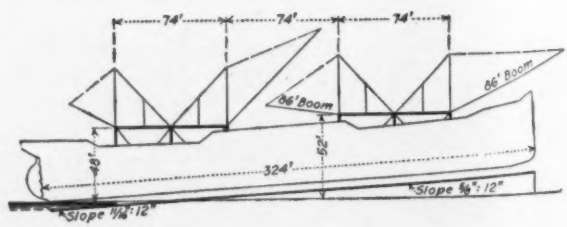


FIG. 2. TWIN BERTHS BETWEEN GROUPS OF DERRICK TOWERS AT SUBMARINE BOAT CORPORATION YARD—STORAGE SPACE AT HEAD OF WAYS PERMITS CONCENTRATION OF MATERIAL FOR QUICK ERECTION

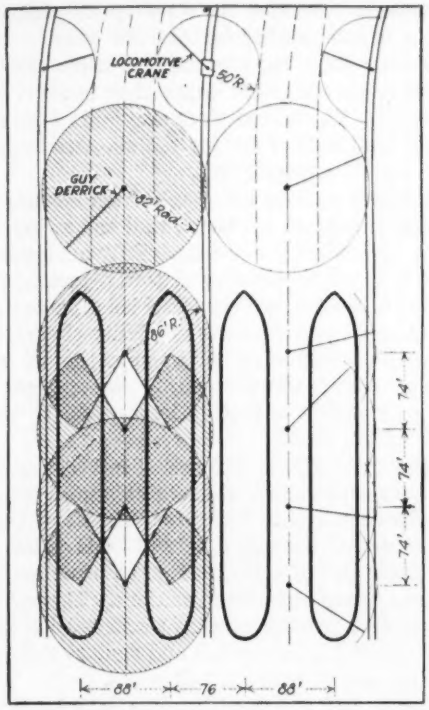


FIG. 3. DERRICKS REACH TWO SHIPS—FOUR HOISTS CAN BE PUT TO WORK ON ONE SHIP

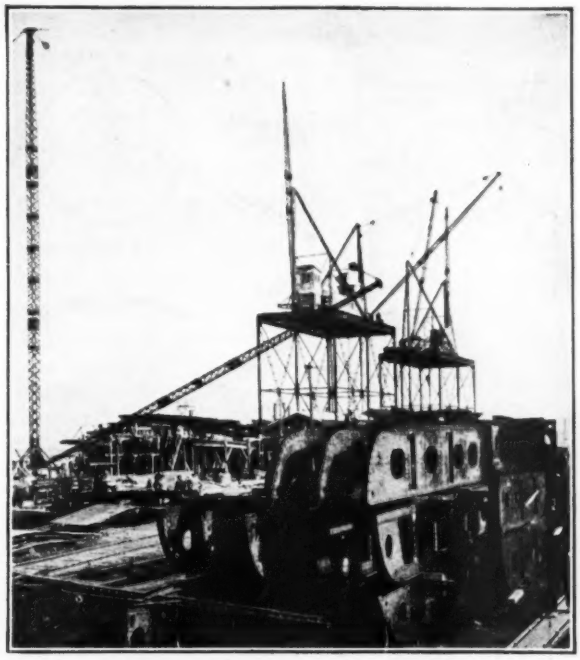


FIG. 5. A TWO-SHIP ERECTION UNIT

period would be much greater than this. The average weight of an erection piece is 1 to 1½ tons, and thus the mean rate of working of the hoists would be 20 to 30 operations per day, and the maximum perhaps 100. The experience of the field erection men in the Corporation's organization indicated that two derricks could handle this service easily.

The weight of the parts to be handled is not great. Ordinary floor sections and keelson girder pieces weigh about 1½ tons each. Shell plating does not exceed two tons per piece. Some individual parts range to more than five tons in weight, as for example the rudder frame (seven tons). There are one or two lifts con-

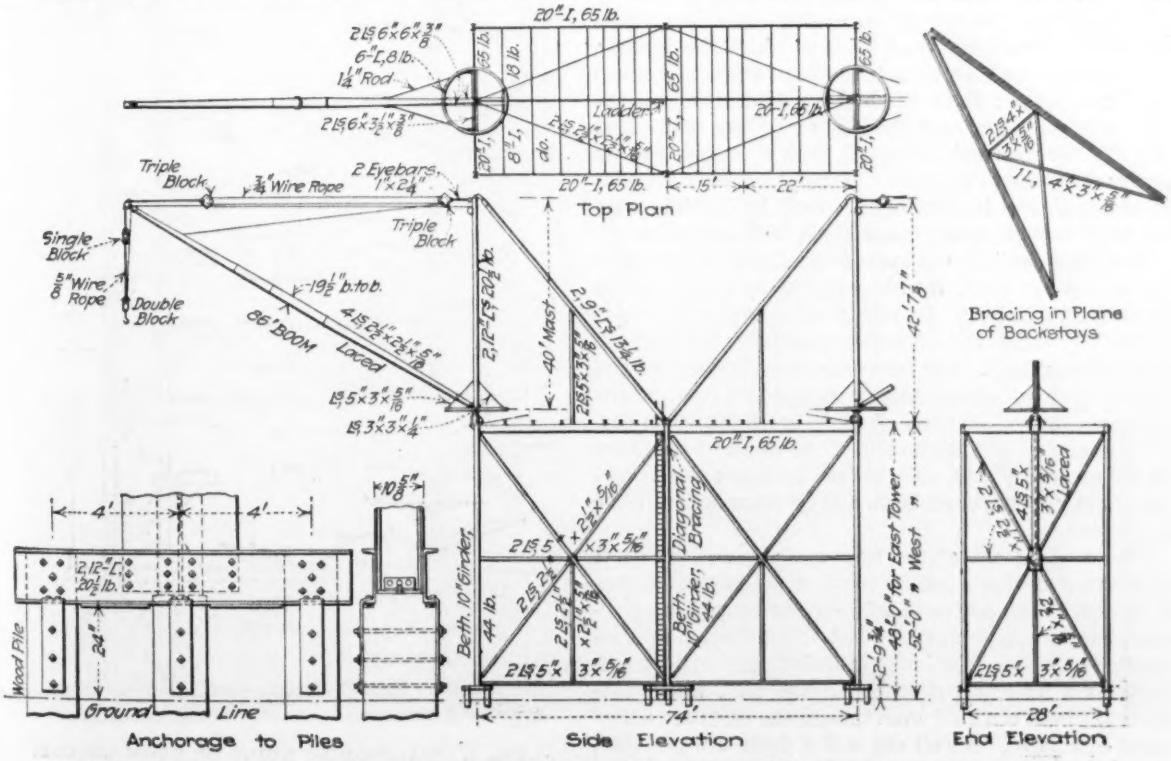


FIG. 4. TOWER CARRYING TWO DERRICKS OCCUPIES 28-FOOT WIDTH BETWEEN SCAFFOLDING

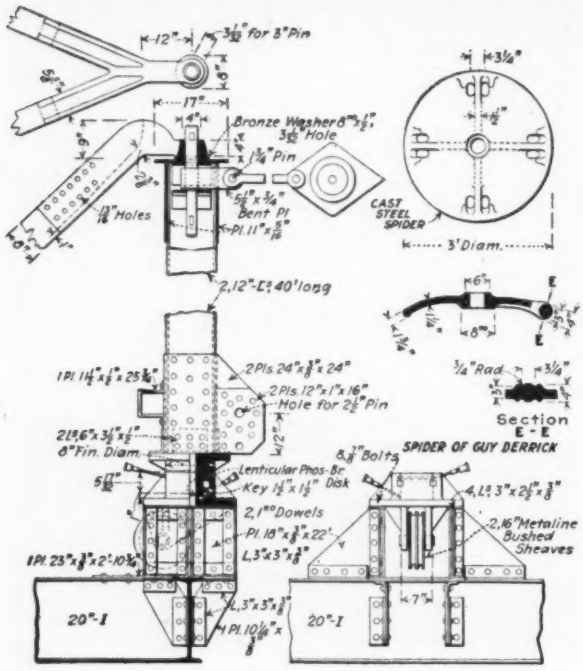


FIG. 6. DETAILS OF MAST BEARINGS AND STEP

siderably heavier. The alleyway shaft housing, weighing 16 tons, is the heaviest. The use of derricks of 7½-ton capacity was decided upon, the few heavy lifts to be handled by two booms through an equalizer beam.

The reach of the derricks was fixed at 86 ft., which, with the arrangement chosen, brings the center of the hoist several feet beyond the single track between the ships, with the boom horizontal. The ship is built up to a height at the bow of something more than 60 ft. above the ground, but the towers on which the derricks are mounted are high enough to give a substantial margin beyond this; their heights are 48 and 52 ft., the higher tower being near the bow or inshore end. Last fall the Government indicated that it might require larger ships than the present 5500-ton vessel to be built at the yard, and in view of this fact the derricks were set high enough to accommodate a 9500-ton ship.

The four derricks are spaced equally along the ship, 74 ft. apart. Each tower, carrying two derricks, is therefore 74 ft. long. Its width was made 28 ft., which is the full available width between scaffolds if a 9500-ton ship is being built. The tower structure is quite simple. The bracing extends to the ground, and as a result of the absence of portal stresses all parts are light. The derricks are stepped at the middle of the width of the tower in the two end planes, and the load from the step is carried jointly by the cross-beam and by truss action in the end bracing.

The derricks are of the type used in steel erection, and do not depart much in detail from customary construction. With a view to long continuous service, however, special attention was given to lubrication and reduction of wear. The lower mast bearing, as sketched, contains a lenticular phosphor-bronze disk, which supports the mast centrally even though the parts are out of exact alignment. An oil cup and a drain are provided, and the top of the bearing is sealed by a felt washer. The gudgeon at the top of the mast has a metaline bushing and a bronze washer to take the wear.

To reduce wear of the rope sheaves of the derrick rigging were made somewhat larger than is usual in erection practice. Three rope sizes are used: ⅝ in. for the three-part load falls, ¾ in. for the six-part boom falls, and ⅞ in. for the swinging line.

The hoisting engines are single-drum electric hoists, with separate engines for boom, load and swing, but all three are operated by one man. This arrangement is expected to result in a saving of power, because smaller motors are used than in a combined hoisting engine, and also is believed to give greater reliability of service, as a motor failure would affect only one motion of the derrick. The specifications required the engines to be capable of exerting a pull at least equal to the safe strength of the rope.

The power supply is 220-volt direct current. The motors are series-wound, which affords good torque and control characteristics. The power circuit of the boom falls is connected through a pair of limit switches that cut the motor out of action when the boom approaches its extreme upper and lower positions. This gives protection against putting excessive compression into the boom by topping it up too far, and against risk of damaging it by contact with the bull-wheel.

The towers and the derricks were built by the Lackawanna Bridge Co., following designs of the Submarine Boat Corporation. The latter fitted the blocks and rig-

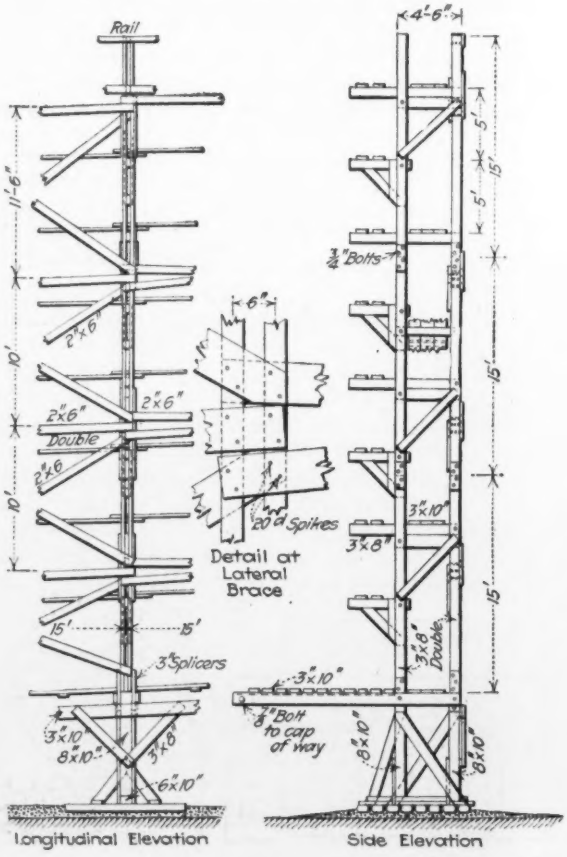


FIG. 7. SCAFFOLDING BUILT UP FROM GROUND, ALONGSIDE THE WAYS

ging. The hoisting engines were built by Orr & Sembower, Reading, Penn.

Special study was given to ship erection scaffolding. No commonly used or standard form of construction could be found, but with the varying sizes of ships built in the regular commercial shipyards the scaffolding usually grew as conditions dictated.

The Submarine Boat Corporation's erection scaffolding is built up from the ground instead of being set on the way platform as is most commonly done. To make this possible the platform is kept narrow, being built 32 ft. wide, so that the parallel body of the 5500-ton ship overhangs 7 ft. on each side.

The sketch, Fig. 7, shows a typical scaffold bent. The scaffolding along the sides and around the bow of the ship is to be permanent, left in place after the completion of a vessel. During the erection of the first the scaffolding is built up in successive stages as required, and the hoisting of material is not affected; during the construction of the succeeding ship the material will have to be hoisted over the scaffolding.

Ship construction at the yard is well advanced, and the "Agawam," the first hull, was launched May 30. Nevertheless, no rapid rates of erection have yet been attained, and neither the layout nor any of the equipment has been put to a test of its capacity. The prospects are that the coming two months will see material arriving in the yard fast enough to crowd the ship erection to a maximum.

Previous experience of the Submarine Boat Corporation in constructing navy patrol boats in quantity furnished the basis for the layout and equipment planning. The ideas of all the leading men in the organization joined in working out the design of the equipment. The Lackawanna Bridge Co. and the Worden-Allen Co., several of whose officials hold prominent positions in the Corporation, contributed most of the experience in steel-erection methods.

Three New National Forests in the East

A proclamation establishing three national forests in the East has been issued by President Wilson. The White Mountains National Forest, located in New Hampshire and Maine, now includes 267,000 acres for which title has actually been taken. In addition, about 124,000 acres have been approved for purchase. This national forest is designed to protect the drainage areas of the Androscoggin, Saco, Connecticut and Ammonoosuc rivers.

The Shenandoah National Forest, in Virginia and West Virginia, now includes about 100,000 acres for which title has been taken, and 65,000 acres more have been approved for purchase. Most of this land is in the drainage area of the Shenandoah River, but portions of the Potomac and the James Rivers are included.

The Natural Bridge National Forest, in Virginia, is designed to protect a portion of the drainage area of the James River. The Natural Bridge is within three or four miles of the boundary. The Government has taken title to about 73,000 acres, and 29,000 acres more have been approached for purchase.

Two other national forests in the East have previously been proclaimed. These are the Pisgah in North Carolina and the Alabama in the state named. All are established under an act of Congress of 1911.

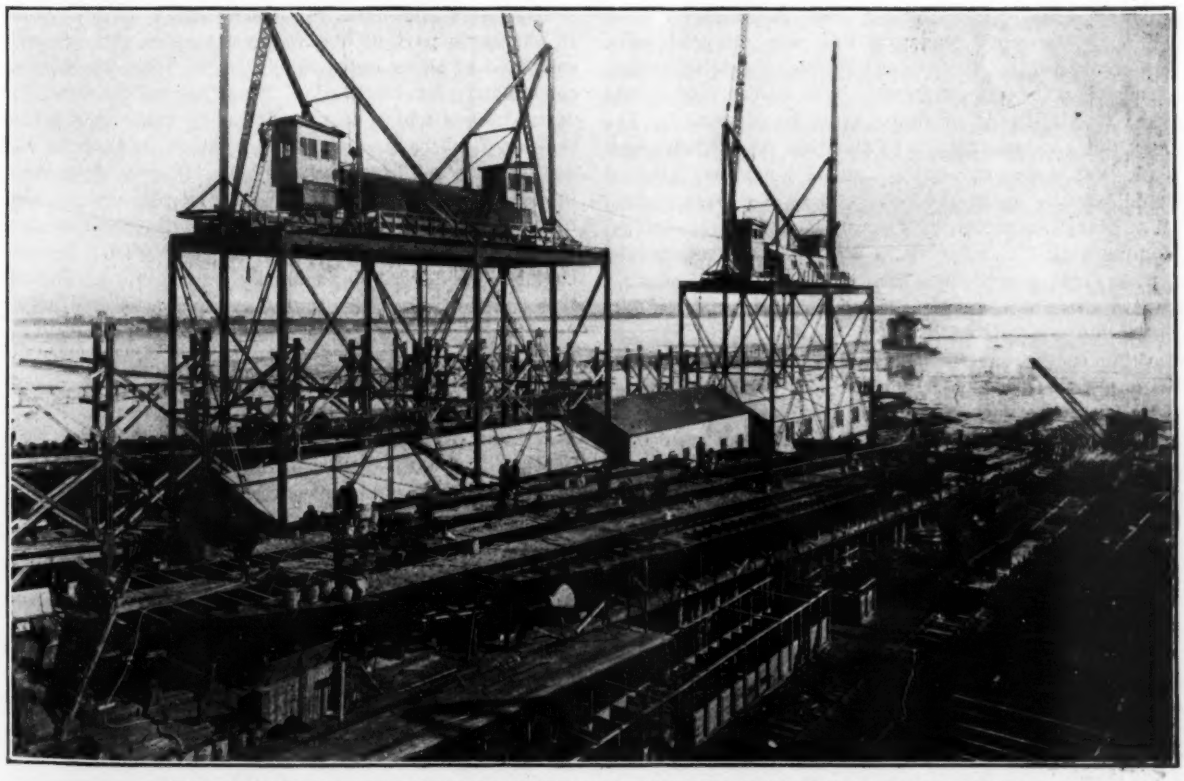


FIG. 8. FOUR TOWER DERRICKS COMMAND TWO SHIPS—MATERIAL DELIVERED BY TRACK BETWEEN SETS OF TOWERS

Building Roads at the Front

Director of Roads for Fifth British Army Tells Canadian Engineers of Some of the Difficulties Overcome

ROAD-BUILDING in the war zone has, among other interesting problems, the organization of the labor, utilization of the materials at hand, the overcoming of military prejudice in superior officers and the speed with which work must be accomplished in trying circumstances. These are some of the difficulties that confront the engineer on active service, Lt. Col. William G. MacKendrick, D. S. O., told the fifth Canadian Good Roads Congress, held at Hamilton, Ont., May 7-10. A brief summary of his address follows:

All classes of labor are used, including German prisoners, Indian cavalry, West Indians, Chinese, Belgian refugees, and English and Canadian labor battalions. The most efficient of these are the Canadians, because they are more adaptable to conditions, and whether it be fighting, building roads or the special work for which they are using the railway construction troops so much and so effectively on the fighting fronts, they are keener to get on with the job. Not only do the classes of labor differ in language and general characteristics of work, but also the living conditions hinder their efficiency. It often happens that they are quartered at long distances from the work, as was the case with a Belgian force working on one job. They were 12 miles from quarters, and the only wonder was that anything could be accomplished with them after such a morning walk.

Road Department Had to Prove Its Worth

During the early stages of the war all road work was controlled by the regular military establishment. Later, when the new road department was formed, it was found that military prejudice must be overcome. The army did not take kindly to the new department, and would not coöperate with it until convinced that it would actually produce results. They also were jealous of military authority. "They told me," said Colonel MacKendrick, "that for me, a lieutenant-colonel, to take a pick from a private's hand and show him what I wanted done would prove ruinous to army discipline. But it did not, and within a month we had 12,000 men working to the one idea and with the one policy, and doing fine work for the use of the fighting troops."

Business methods, or rather the lack of them, is another problem. In the force of Belgians mentioned above there were 30 gangs. Each gang had a foreman who had entire responsibility for the organization, direction and paying of his force. At the end of the month the paymaster handed him the necessary cash for payment, and he distributed it without any check whatever as to whether it reached its proper destination, or whether he had reported the correct number of men employed, or the hours actually worked. This system was changed, and soldiers were appointed as timekeepers, thus saving the treasury about 30,000 francs per month. Modern business methods of handling these men nearly trebled their output in many cases. This was accomplished in the quarries, and in the woods where they were getting out defense pickets, posts and other timber. On the actual road construction the output was doubled. The Belgians, under proper superintendence, make excellent workmen.

Long distances are the rule in the war zone. A lieutenant-colonel on road construction may have, at one time, 700 miles of road under him. Although he may have considerable territory to cover, and a large number of workmen to watch, still, if his name is not on the list of officers entitled to a horse or a motor, that settles it, he must do the best he can on foot.

Miles of Broken-Down Roads Repaired

Roads which before the war were in good repair, parts of the Routes Nationales, were pulverized by the traffic of heavy guns and 17-ton caterpillars, and were rapidly destroyed. In the early part of the war, it was impossible at times to repair them, because of lack of material and facilities, and in the fall of 1915 the British Army had to stop fighting because the roads could not carry the needed materials. Early in 1916, Lieutenant-Colonel MacKendrick was sent to the Somme to build roads for the Fifth British Army. There were 250 miles of broken-down roads that they had been fighting over for months. These roads were practically gone, and in many places the center was a ditch with from 8 to 10 in. of mud of the consistency of pea soup. They wanted these roads rebuilt in a hurry, so that they could fight over them again within three months. However, there was no stone for fixing them. These conditions were reported to the British cabinet by Sir Eric Geddes, and soon after, when he was placed in charge of transportation for the Army, the much-needed road materials were supplied.

The materials used for construction at the front in the early part of the war were often strange, and consisted of those upon which the engineer could most conveniently lay his hands. There are village sites, the population of which was numbered by thousands before the war, where every available stick and stone has been put to military uses. The brick and stone were taken for the roads, the timbers and plank were used to bridge shell holes, and what was left the advancing army used for campfires to cook their food. A more complete obliteration can hardly be imagined. But all this changed when the road department became better organized. Stone and facilities for hauling it were supplied, and plank in quantity was furnished for the roads on the shell-pitted areas behind the lines.

The principal material of the road engineer in France is the soft French limestone which is used in the form of macadam roads. With it the French highway engineers saved Verdun, maintaining a motor transport system over macadam roads for three months after the front. The Frenchmen ran motor freight trains at Germans had broken the only railroad leading to that definite intervals, and operated them on schedule like a railroad.

For the heavy traffic it has been found better to discard the old French telford construction, which consisted of setting the large stone on edge in the bottom and covering with small stone, for a substitute construction using the large stone laid flat. This gives greater bearing power, and laid in this manner, with 9 in. of 4-in. stone for surfacing, the road will carry

more load than 20 in. or even 30 in. of stone laid by the old method. The best sizes of stone to carry the motor traffic at soft spots are the 4-, 5- and 6-in. Because of the softness of the stone the smaller sizes, such as 2 in., "mush up" when wet, and do not have the bearing power.

Close behind the lines, however, where the ground is dotted with water-filled shell holes from 5 to 15 ft. in diameter, as it was in Flanders, a macadam road built in a hurry is an impossibility. Under these circumstances plank is the only thing that saves the situation. It will cost less, can be built twenty times as fast, and over some kinds of ground will carry more load than stone. Three-inch plank laid upon railway ties give the best results. In his reports Sir Douglas Haig stated that without the plank roads at Vimy Ridge, Passchendaele and Messines it would have been impossible for the army to advance.

In this kind of work the life of the road is short. Even 6 in. of stone on a good foundation will be ground to powder and will blow away in six weeks. It is of most importance to give the road a good crown, roll it where possible and keep it perfectly maintained. In this connection Colonel MacKendrick paid a fine tribute to the efficiency of the French engineers. He stated that, in his opinion, the French are the finest road repairers in the world. They are economical in roadbuilding as they are in everything else. They make a barrow load of stone reach as far as a cartload usually goes. The reason is to be found in their system of incessant vigilance, patching the small holes as soon as they appear.

Organizing America's Research Work On a National Scale

Council Dealing With Scientific Aspects of War—Aims to Co-operate With and Aid Individual Workers

By Charles Whiting Baker
Consulting Editor, Engineering News-Record

THE proposal has been made many times that the work of scientific and technical research, now carried on independently by a multitude of institutions and individuals, should be organized on a national scale. Such an organization, could it be effected, would make unnecessary a vast amount of needless duplication of work. It would further be possible, by concentrating research workers on a particular task, to make much more rapid progress; and by giving the results of successful research greater prestige and standing, it would be possible to secure the adoption of new developments in practical work to a much greater extent than at present. The magnitude of the task of controlling and coördinating the research work of the entire country is such, however, that no serious attempt to do this was ever undertaken until the war brought home the need and opportunity.

Two years ago President Wilson accepted an offer by the National Academy of Sciences to undertake the organization of the scientific resources and research facilities of the country. The National Research Council was organized, in accordance with this offer, a year in advance of this country's actual declaration of war, and it was officially recognized by the Council of National Defense. It was arranged early in 1917 to have it serve during the war as a department of that body.

While the National Academy of Sciences, from which the National Research Council sprang, deals only with so-called "pure" science, it was recognized from the outset that the business of the Council was to promote research which aimed at definite, practical results.

The executive order of President Wilson, issued on May 11, recognized the work which has already been accomplished by the Council and ordered the coöperation with it of the scientific and technical branches of the Government. The practical nature of the Council's work was attested at the outset by the fact that its first financial support came from the Engineering Foundation; and is attested now by the fact that Governmental appropriations to the amount of $270,000 have been made to finance special branches of its work.

The work accomplished by the Council and its organization and plans were the subject of an address by the Council's chairman, Dr. George Ellery Hale, delivered on May 28 before a joint meeting of the national engineering societies in New York City.

As much of the research directed by the Council relates to apparatus useful in the war, detailed statements concerning such work cannot be made public. It can be said, however, that among the problems with which the Council is dealing are processes for making nitrates, the manufacture of optical glass, materials conveniently located for highway construction along the Atlantic coast, methods of combating the submarine, the development of body armor, range finders, location of enemy heavy artillery by sound, psychological tests of recruits. These are but samples at random of the numerous fields in which committees of the Council are at work.

Dr. Hale, in his address, emphasized that the Council recognizes the great value of individual initiative and direction. It will aim to coöperate with and aid the individual worker and not to supersede him. A statement of Dr. Hale's which won hearty applause from his audience was the following:

"It should be said here, once for all, that the policy of the National Research Council has been from the outset invariably to recommend the immediate development and utilization for military and naval purposes of the best devices or methods known at the time, with the understanding that research for the purposes of improving such devices should not retard production demanded to meet pressing military needs."

In the special work of coöperating with existing research agencies, a census has been made under direction of Dr. S. W. Stratton, chief of the Bureau of Standards, of the research workers and facilities in the universities, manufacturing plants, Federal Government bureaus, commercial testing laboratories, etc., throughout the United States. Another committee, of which Dr. John C. Merriam of the University of

California is chairman, has secured the organization of local research committees in 72 universities and colleges to coöperate with the National Council and in many cases with local industries.

There has also been organized, with the approval and coöperation of the Secretaries of War and the Navy, a committee to interchange technical information and the results of research work with the authorities of Great Britain and France. This committee has offices in Paris, London and Washington. Dr. W. F. Durand represents the committee in Paris and Dr. H. A. Bumstead in London. The Council of National Defense has provided funds to the amount of $38,400 for this committee's work for the current year.

In the direct carrying on of research, the Council is coöperating with Government and other organizations, such as the Bureau of Mines, the Bureau of Standards and others. The Division of Engineering is now under the chairmanship of Dr. Henry M. Howe.

At the present time the Council, in conjunction with the Engineering Foundation, is undertaking a campaign for the promotion of industrial research by commercial organizations. This work is in charge of a strong committee on which the heads of the leading industrial research laboratories are represented. To back this movement an advisory committee has been formed made up of such men as the Hon. Elihu Root, E. W. Rice, Jr., president of the General Electric Co., Theodore N. Vail, Dr. Henry S. Pritchett, George Eastman, Pierre S. du Pont, A. W. Mellon, E. H. Gary and Cleveland H. Dodge. This committee held its first meeting in New York City on May 29.

Concrete Viaduct at St. Louis Has Simple Details

Structure Carrying Chouteau Ave. Over Railroad Made Up of Short Slab Spans on Three-Post Piers—Concreted from Several Towers Alongside Bridge

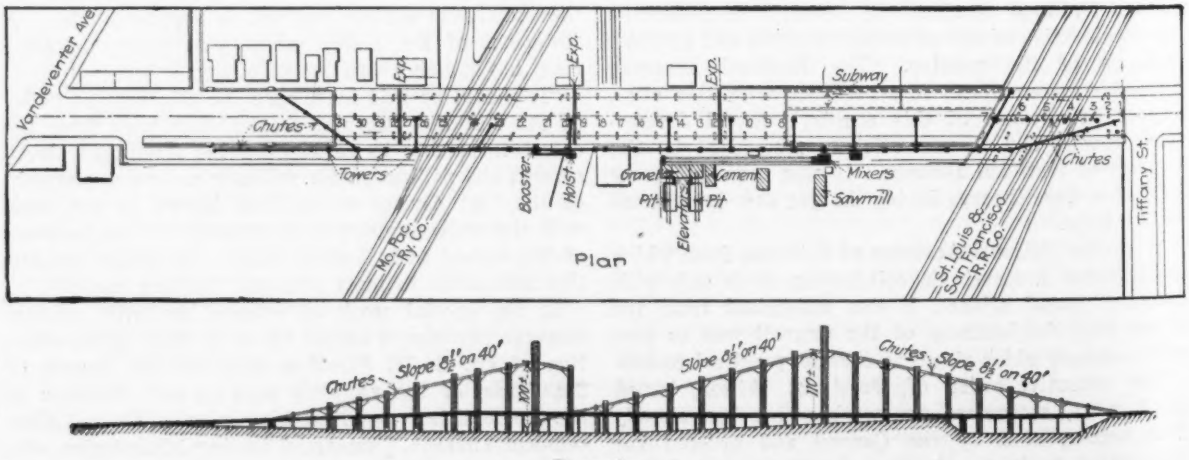
By Charles W. Martin
Woermann Construction Co., St. Louis

SIMPLICITY of design with consequent simplicity in construction is a feature of the Chouteau Ave. reinforced-concrete viaduct recently completed in a busy section of St. Louis. After a thorough study of the possible types of construction available and economical for the location, the city engineers decided upon a series of slabs, curved in the lower surface, and supported on three-pier bents. The analysis of the conditions governing the design and a brief statement regarding the structure and its method of construction are here set forth.

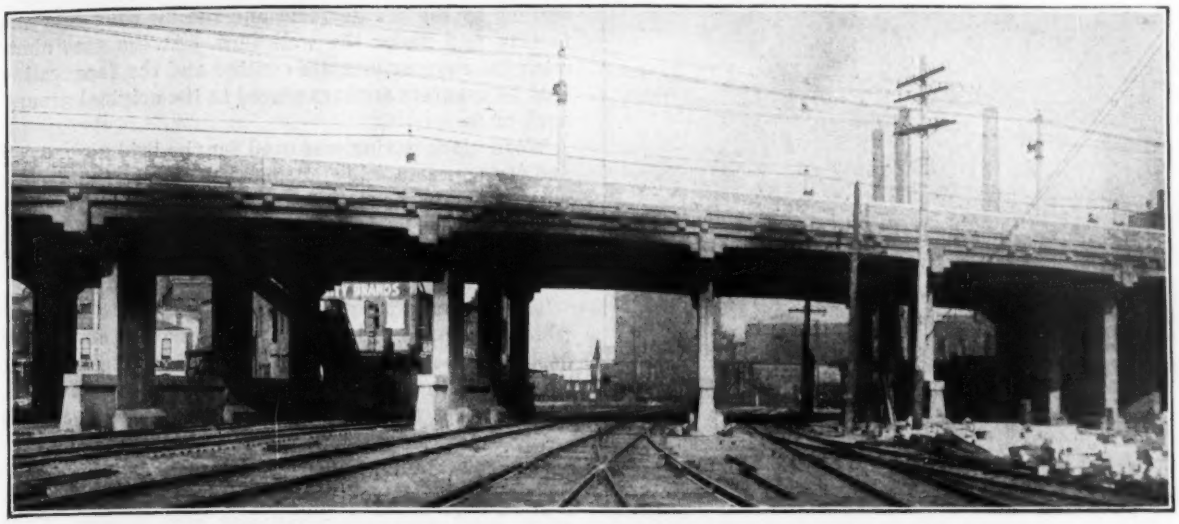
Chouteau Ave. is one of the principal traffic highways in the city. Before the construction of the viaduct it crossed the Missouri Pacific Ry. at grade east of Vandeventer Ave. and crossed over the St. Louis & San Francisco Ry. (Frisco) on a steel bridge of inadequate width at a point about 800 ft. farther east. The limited vertical clearance between a desirable bridge grade line and the railroad tracks, together with the necessity of narrow piers on railroad property, confined the preliminary studies for the design of the viaduct to structures of the beam or slab type. In the selection of a general detail for a reinforced-concrete structure of this type many considerations entered, and the least of these was not cost.

Preliminary to a comprehensive study of detail the character of the soil was ascertained from test holes and the location of bedrock determined by soundings The surface soil was judged fair bearing material, good for say 1500 to 2000 lb. per sq.ft., but not unyielding at that unit. The borings indicated that bedrock was about 10 ft. below the Frisco tracks and falling off toward the west on nearly a straight grade to a 55-ft. depth just west of the Missouri Pacific tracks. The borings also indicated fair digging material all the way to rock.

Sometimes soil conditions are such that the best type of foundation bridge is readily seen, but such



CONCRETE PLACED IN CHOUTEAU AVE. VIADUCT BY CHUTES CARRIED ON NUMBER OF TOWERS



LIGHT SLAB CONCRETE VIADUCT SECTION OVER MISSOURI PACIFIC TRACKS

was not the case here. The conditions necessitated study of the relative merits of three types: (1) A deck system of simple beam elements supported by spread foundations; (2) a deck system of partially continuous beam elements supported on pile foundations, and (3) a deck system of continuous slab elements supported by shaft foundations extending to rock.

The first type offered a cheap foundation and an expensive deck. The third type offered foundations no more expensive than the foundations of the second type and a deck cheaper than for either of the two others. It also offered the thinnest deck and the lowest approach gradients, as well as some saving in the costs of embankment, filling and retaining walls. The third type was adopted.

The viaduct extends from Tiffany St. to Vandeventer Ave. and crosses over the tracks of the Missouri Pacific and the Frisco. It is 1550 ft. long and 80 ft. wide and provides a 56-ft. paved roadway and two 12-ft. sidewalks. The bridge structure proper consists of a main group of 23 spans at the Missouri Pacific crossing and another group of six spans at the Frisco crossing. Between these two groups of spans there is a walled embankment 300 ft. long and 50 ft. wide which is paralleled by a bridged-over driveway entrance, 30 ft. wide, to the Independent Packing Co. The Frisco is in a cut and there the viaduct is terminated with an abutment pier, but to the west of the central group of spans a walled embankment approach of considerable magnitude is required. To provide original street level access to adjoining industrial property there are two 30-ft. driveways along the south side of the structure, which lead up from the original street level under the central span system to the viaduct grade at each end of the structure.

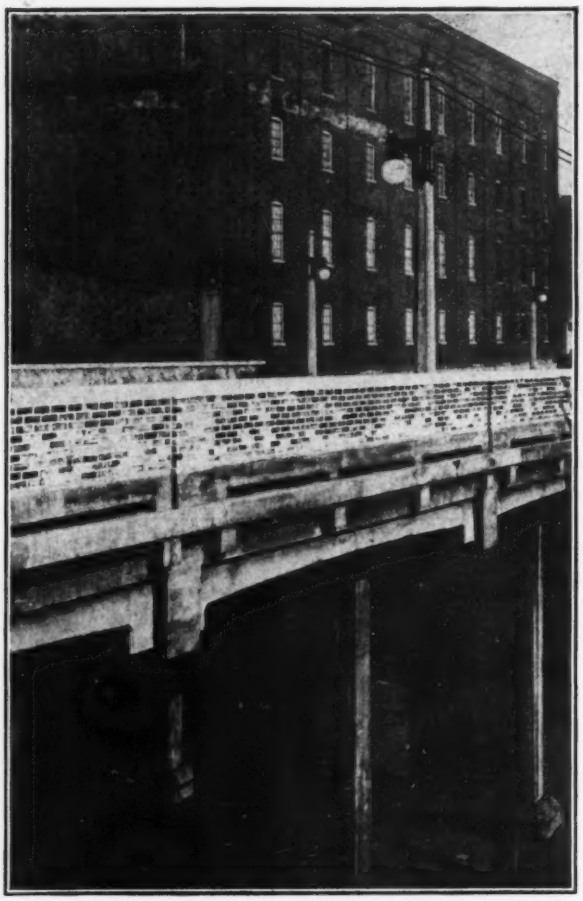
The main central group of 23 spans is divided by three expansion joints into four independent systems. The group of six spans over the Frisco tracks comprise one system. The spans in each system are slightly arched continuous slabs supported by transverse lines of vertical shafts with foundations extending to rock. The slabs are flat on top and over them the pavements and street car tracks are laid as on a street. This necessitates considerable filling concrete and thereby augments the dead-load but offers certain advantages in the way of providing space for conduits and makes certain the attainment of good surface lines and grades. The normal lengths of the spans between center lines of piers are in general 28 and 32 ft. The thickness of the slab at the span centers varies from 20 to 22 in., and in general the thickness over the piers is 4 in. greater.

At the expansion joints in the main group of spans the slab of the adjacent span systems are cantilevered out 7.5 ft. from the piers so as to make up a double cantilever span of 15 ft. At the expansion joints at the ends of each group the slab ends are supported by shafts adjacent to the abutments but independent thereof save for the employment of the same foundations.

In designing the bridge the live-loads considered were: (1) 100 lb. per sq.ft. on the walks; (2) 18-ton road roller and 150 lb. per sq.ft. on the roadway; (3) 55-ton cinder car on one track and one or more 38-ton passenger cars on the other track, the two track loadings being considered to act together on a strip of slab 20 ft. wide.

The operations in the design and calculations of stresses for the various system of spans and piers in the structure may be summarized as follows: (1) Trial dimensions were fixed from a preliminary design made with a normal uniform line live-load. (2) This trial structure was considered loaded with the requisite concentrated live-loads and analyzed with the three moment theory. In this the deck was considered as of constant moment of inertia and the flexural resistance of the piers was neglected. (3) The influence of the variable moment of inertia and (4) of the flexural resistance of the piers was approximated for typical cases. (5) The moments and axial stresses generated in the deck and the moments and shearing stresses generated in the piers by temperature distortions were also approximated for typical cases.

The coefficients from operations 3 and 4 were applied to those of operation 2, and these combined with



BRICK RAILINGS AND ORNAMENTAL LAMP POSTS ARE DECORATIVE FEATURES OF VIADUCT

coefficients of operation 5 to obtain the figured maximum stresses for the various combinations of loadings.

The figured working stresses were limited to values of 700 lb. per sq.in. for bending compression in concrete and 17,000 lb. per sq.in. for tension in steel.

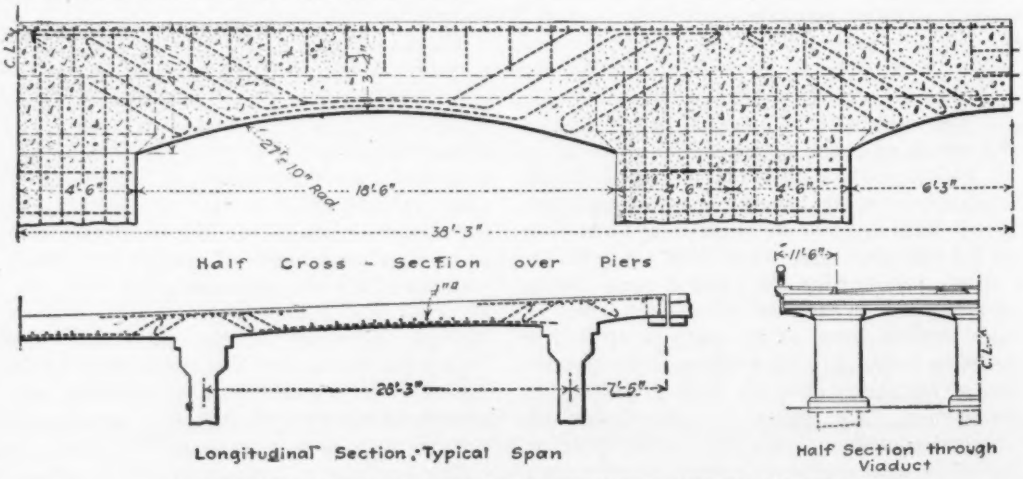
The retaining walls and the abutments are in general of the counterfort type with face walls 2 ft. 3 in. thick. Along the side drives the face construction differs in that the face wall is held up above the foundations by the counterforts and the fill runs over the footing and under the wall face. At the east abutment the counterforts are omitted and the face wall is held by concrete anchors placed in the original ground back of it.

Wood block paving was used for the bridge roadway and the concrete walks are flanked with railings made with concrete base, brick walls and stone coping. Concrete poles back of the curb lines carry the bridge lighting and support the street railway trolley and feed wires.

The pier shaft foundations extending to rock, of which there are 114, are 3½ x 7 ft. in section. Their depth carries from 10 to 57 ft. and averages 37 ft. The soil is in general a fairly stiff damp yellow clay which except for the 5 or 10 ft. just above rock was easily excavated without picks. Some seepage water was encountered just above the rock, but it offered no great hazard to the work. In excavating these holes hand operated windlasses and wooden stave buckets generally were employed after a depth of 10 ft. was obtained by direct hand shoveling. For a few of the greater depth holes steam hoists and A-frames were used to lift the buckets.

As the excavation progressed the holes were walled with horizontally placed 2-in. sheathing with cleated ends and braced by one central system of 6 x 6-in. vertical sills with 4 x 4- or 6 x 6-in. shores at from 3- to 4-ft. centers. At one hole a pocket of quicksand was encountered and steel-sheet piling was required. The holes were filled with 1:3:6 concrete. In general the bracing was left in place.

The capacity of the concreting equipment was fixed in the specifications. The requirements were as follows: "All batches of concrete, except the concrete for foundations extending to rock, shall be mixed continuously through a period of not less than 3 min. after the ingredients have been placed in the mixer. . . . The capacity of the concrete equipment . . . shall not be less than 450 cu.ft. of concrete, in place, per working hour. The arrangement of plant or plants shall be such that this rate of concreting may be attained at any point where 4000 or more cu.ft. of concrete are embraced in a single unit of construction. . . . Each portion of the concrete work



A TYPICAL VIADUCT UNIT FOR THE CHOUTEAU AVENUE BRIDGE

. . . which is contained within the limits of the lines shown or indicated on the drawings as construction joints . . . shall constitute a unit of construction and shall be completed . . . in one continuous run or operation. . . . The largest . . . contains 11,400 cu.ft. of concrete." The contractor's concreting equipment was designed to meet these requirements. It consisted of a central mixing plant and a system of towers and chutes, as shown in the drawing herewith.

Material bins were placed at the only available railway switch and elevated so as to allow cars to pass underneath. They were divided into three compartments, two for different sizes of gravel and one for sand. Material was received in bottom-dump cars, discharged into pits and elevated with belt conveyors. The cement house was located just east of the material bins.

The Mixing Plant

The hoisting tower was about 140 ft. high. It was placed about 250 ft. east of the bins, so that one run of chutes would reach the east end of the viaduct. Small tramcars were employed to transport the materials to the mixer plant. These cars were divided into compartments and received a complete mixer batch. They were pulled to the mixer by team and returned on a gravity track. The mixing plant consisted of two 24-cu.ft. mixers driven by 20-hp. motors. Batches were handled alternately out of the two mixers by a 500 volt d.c. hoist of 70-hp. capacity. The maximum capacity of the plant was about 700 cu.ft. of "3 minute mix" concrete per hour.

Located along two-thirds of the south side of the viaduct was the main longitudinal chuting system with transverse chutes leading off at intervals. The system consisted essentially of a series of bridged chutes supported by towers at about 40-ft. centers. The chutes were built on a 21% grade and lined with galvanized iron. To serve the west one-third of the viaduct a booster or pick-up station was placed at the end of the main chute. There the mixed concrete was received in a hopper, elevated again and distributed by a further system of chutes.

Novel Methods in Form Work

Some novel methods were employed in the formwork. Over the railroad tracks the forms were supported on framed trusses which were made as units and reused. For the vertical walls and piers a system of rectangular unit forms were employed. They were generally made in sizes which could be handled by two or three men.

The cost of the viaduct, not including land damages, was about $200,000. Of this about $145,000 is the cost of the foundations and superstructure and $55,000 the cost of the pavements, railings, light poles, conduits and fixtures.

The contractors for the main structure were F. C. Mueller & Co. of St. Louis. E. R. Kinsey is president of the Board of Public Service and L. R. Bowen is bridge engineer. W. R. Crecellius was in charge of the construction for the city. The writer designed the structure while in the city's employ.

Clean Old Ditches to Take Run-Off From Bluffs Without Silting

Caving Banks, Silt and Concentrated Run-Off Keep Lands Wet—Ditches Enlarged—Flood-Gates Improve Condition

EFFICIENCY of 12-yr. old drainage ditches on a 50,000-acre district in Iowa had become impaired to such an extent that the lands were too wet for successful cultivation. A general improvement of the entire ditch system was made, clearing out the accumulations and giving flatter slopes to the banks. Iron pipe culverts with floodgates at the outlet end were replaced by concrete culverts having the floodgates at the inlet end and having a vertical shaft or manhole for access to the gate.

This work is on Farmers Ditch and Drainage District No. 1, of Woodbury County, Iowa. The land lies between the Chicago & Northwestern Ry. and Chicago, Milwaukee & St. Paul Ry., and extends from the bluffs at Sioux City to the Monona County line. It is in the Missouri River bottoms and is very productive, but normally too wet for farming.

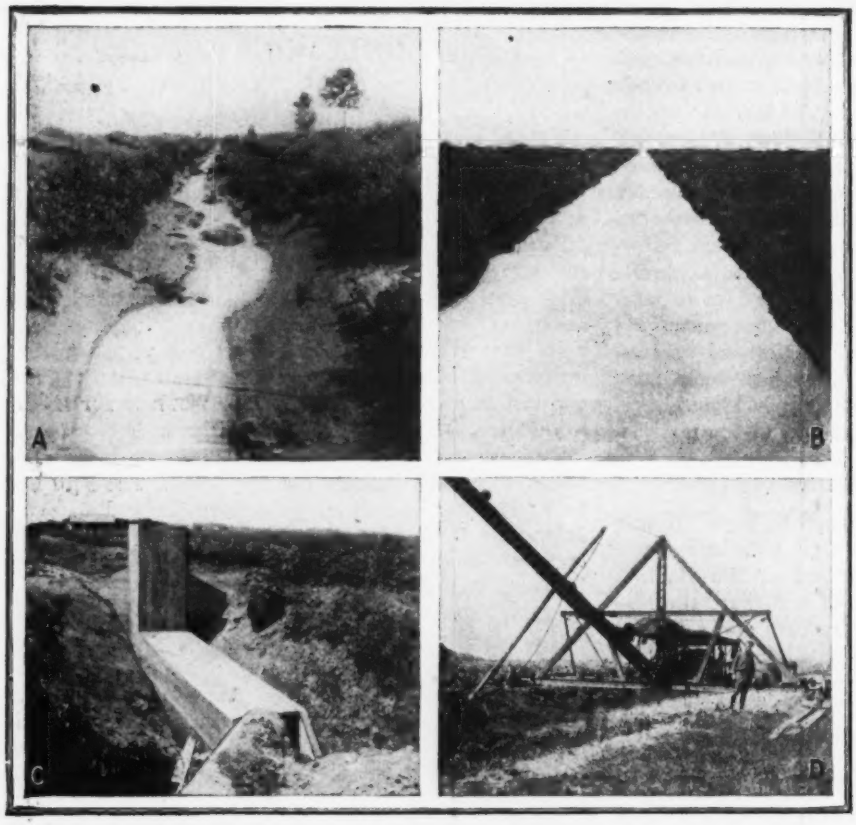
The main ditch was made originally with side slopes too steep for permanence, so that the banks slipped and caused obstruction of the channel. Silt coming down from the bluffs also partly filled the main ditch and worked back into the branches. The district then became so wet that the board of trustees ordered the ditches cleaned in such a manner as to provide satisfactory drainage. The contract for this work was let in September, 1916. For the main ditch the engineer specified slopes of 1 on 1½ to prevent further slipping.

Conditions of Run-Off

The nature of the topography in this district results in the sudden delivery of a very heavy run-off from the hilly portion of the watershed at times when there is little or no water being delivered by the level lands immediately adjoining the main ditch. This excessive periodical discharge carries a heavy burden of silt and debris. With this run-off it often happens that the stage of water in the main ditch is very high, while the laterals which receive their water from the level lands in the immediate vicinity are carrying very little water.

The result is that much water from the main ditch backs up into the laterals and is held there until such time as the water from the hilly districts has passed. It then recedes gradually, after having deposited most of its burden of silt in the laterals. To combat this condition, corrugated pipes with the ordinary automatic floodgates were installed in some cases. These gates would close and protect the laterals from the "back-up" water as long as they were in good working order. It was found difficult however, to keep the gates in repair, especially as they swung out into the main stream and were frequently broken and damaged by floating ice and logs.

To avoid this difficulty, the engineer in charge of the work has designed a floodgate device which works quite satisfactorily. The idea is to make a permanent structure with a floodgate which will be easily accessible and will



A. OLD MAIN DITCH CAVED IN AND SILTED UP. B. MAIN DITCH AFTER CLEANING WITH A FLOATING DREDGE. TOP WIDTH IS TWENTY-FIVE FEET. C. CULVERT THREE BY THREE FEET WITH MANHOLE OVER FLOODGATE AT INLET END. D. MAIN LATERALS CLEANED BY DREDGE STRADDLING DITCH

be protected from floating material. The old pipes were all removed and replaced with rectangular reinforced-concrete culverts, each provided with a heavy wooden gate. This gate is located at the land end of the structure, and in opening it swings into the barrel of the culvert. A rectangular well or manhole is provided directly over the gate, and is built up high enough to prevent any water backing out over its top.

Ordinary wing walls are constructed on the upper or land end of the structure; the lower or outlet end has no wing walls and is cut off on a slope which conforms with that of the ditch. Where the lateral enters at anything but a right angle, the culvert is built to fit this angle, making the upstream wall shorter than the other and the top slab shorter than the bottom slab. Some of the larger structures have two openings 6 x 6 feet.

The use of this type of culvert and floodgate is found to lessen the friction of the stream by presenting no unnecessary obstruction. When equipped with a good substantial gate it is expected to be practically indestructible and easily maintained. About 20 of these structures have been built.

The wider part of the main ditch was cleaned with a floating dredge. The base width was 19 ft. at the point where the machine started, and increased to 30 ft. at the outlet. With the new slope of 1 on 1½ required by the engineer this gave a top width of 67 ft. to 78 ft. The machine was a Marion ditching dredge having a 2-yd. dipper, 60-ft. boom and 28 x 84-ft. hull. Operating day and night shifts it advances about 9000 ft. per month, handling 80,000 to 90,000 cu.yd. of pay excavation. The contractor states that it has been customary to use drag-line machines on work of this kind, operating one on each side of the cut. This would require four crews and give a capacity of about 70,000 yd. per month.

For the upper end of the main ditch, where the width is not so great, and also on the main laterals, two Bay City machines are used. The branch ditches are cut with 1 on 1 slopes, 6 ft. base and round bottom. Both machines straddle the ditch. One operates on a track. The other has the Bay City "walking" device, with a spread of 33 ft. between the feet. It cuts a clean, smooth ditch, and requires only two men per shift to operate it. It has not been in operation long, but its capacity is estimated at 20,000 cu.yd. per month on this class of work. Some laterals along the highway are being handled with a drag-line of the Turner type, made by the United Iron Works Co., of Springfield, Mo. It carries a 1½-yd. bucket and 40-ft. boom. The machine stands on the highway, cutting the ditch at one side and depositing the material at the opposite side. On account of the growing crops, fences, shade trees and other obstructions along the highway, it has proved very successful. It requires three men to operate it.

These small ditches have light yardage, the excavation running from ¼- to 1½-yd. per lin.ft. of ditch. This machine has completed 1800 ft. of work in five days, and then was only five hours moving 1½ miles to the next ditch. This time included two hours spent in reinforcing and bracing a bridge that it was necessary to cross. The machine weighs 35 tons, but having a long wheelbase it can cross over highway bridges by placing an extra bent under them.

The Bay City walking dredge and Turner drag-line machine are both operated by oil engines. The consumption per day, on single-shift work, is about 20 gal. on the former and 25 gal. on the latter.

The work is under the supervision of C. Moriarty, civil engineer. The contractor for excavation is H. B. Whitney. Cheeley & Irish are the contractors for concrete work on the small laterals. All of these are at Sioux City, Iowa.

Special Level Rods Facilitate Light Highway Grading

ON ALL highway grading, where the depth of excavation seldom exceeds 2 or 3 ft., the following method can be used to good advantage for checking.

A pair of 8-ft. rods are graduated to feet and tenths, and each is fitted with an iron spike sliding in metal straps, as shown in Fig. 1. The graduations are numbered both ways from the middle of the rod as zero,

FIG. 1. SPIKE TO SUPPORT ROD

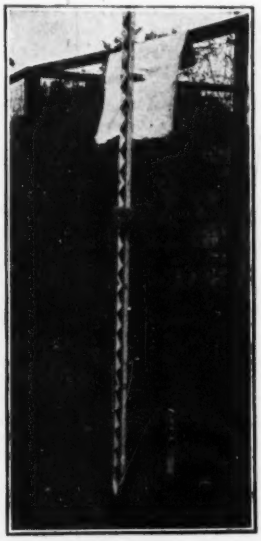


FIG. 2. GRADUATION OF THE ROD

the upper half being used for fill and the lower half for cut readings, as shown in Fig. 2.

Suppose a cross-section calls for a cut of 1.23 ft. on one side and a fill of 1.07 ft. on the other. The grading stakes a-a have been set outside the line of the work, and the witness stakes marked with the station, the distance out from the center and the amount of cut or fill from top of peg to grade. The target on the right-hand stake is set to read "cut 1.23" and stood upon the right-hand peg. The other target is set at "fill 1.07" and the stake set on the left-hand peg. The targets now define a line c-c 4 ft. above and parallel to the

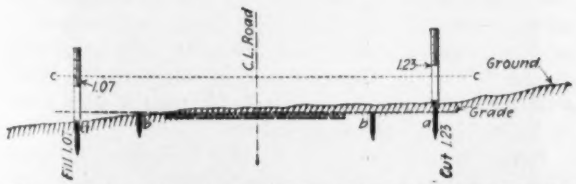


FIG. 3. LINE C-C IS FOUR FEET ABOVE DESIRED GRADE

finish grade line, and the finish stakes b-b may be set by sighting across the top of a 4-ft. rod held upon them. This short rod should be lengthened by the thickness of the pavement when used to check the subgrade.

Two laborers can make good progress with this method, with small chance for error, and all subsequent surveys may usually be dispensed with.

The rod shown above has a plumbing level fixed on the back at the zero point, making it practically universal for survey use. Besides being a cross-section, leveling and stadia board, it makes an excellent fixed backsight when it is stood edgewise and plumb on the hub.

Inflammability of Creosoted Timber Decreases With Age

ACCORDING to a paper by Hermann von Schrenk in the April issue of the *Quarterly* of the National Fire Protection Association, creosoted timber decreases in inflammability with age. When freshly treated such timbers are highly inflammable, due no doubt to the giving off of gases of a highly inflammable nature.

As the creosoted timber ages, there is a marked reduction in inflammability, until after five or six months it will have the same degree of inflammability as untreated timber, and from then on becomes less inflammable. The reason for this is that the high flash point of the oil usually used requires a very high initial temperature to set the same on fire. This is particularly true of the oils used at the present time, the flash point of which is about 280 ° F., whereas the oils used some years ago had a flash point of about 210° F. As the oil evaporates, the compounds left in the outer layers on the outer surface of the wood require an increasing temperature to set them on fire. After a creosoted stick of timber starts to burn, it appears to burn fiercely, making a large amount of black smoke. After the fire has gone out, it will be found that a surprisingly small amount of charring has taken place, due doubtless to the fact that the heat generated by the burning of the outer layers causes the creosoted oil to be fed from the inside of the stick very much after the nature of a wick.

In other words, the oil burns, but the amount of heat developed is largely used up in vaporizing the oil, leaving the wood more or less protected. This has frequently been experienced on burning bridges, where the creosoted stringers have caught fire. After the fire the stringers were found to be charred, but they had been only slightly weakened, and in many instances were still able to hold up the structure. Based on the results of both theoretical and practical experience, it may be said that creosoted material when used with proper design is somewhat less subject to ignition, consequently it can be regarded as a safer risk than untreated timber. One additional reason for this is that the untreated timber, particularly if it has sapwood, starts to decay, and the punky decayed timber offers a good point for starting a fire.

Water Companies Must Pay for Meters

Under a number of recent rulings by the Pennsylvania Public Service Commission, where a water company compels consumers to pay for water at meter rates the company must provide the meter and install it at its own expense. A similar ruling has been made regarding services between the corporation cock and the building line, including the stop-cock and curb box. F. Herbert Snow is chief and H. E. Ehlers assistant chief of the bureau of engineering of the commission.

Overstrain and Fatigue Failure of Steel As Related to Grain Structure

Microstructure Furnishes Explanation of Mechanical Phenomena — Granular Structure —Slip Bands Produced by Overstrain—Amorphous Films Between Grains—Fatigue Failure Develops From Intergranular Cracks

By Henry S. Prichard
American Bridge Co., Pittsburgh

CHANGES in dimensions and shape of a piece of metal due to strain are brought about either in the first of two certain ways, or in both of these ways in conjunction, depending on the severity of the straining. When the piece is strained moderately, the changes in dimensions and shape are effected entirely by changes in dimensions and shapes of the particles of the piece, without any sensible slipping of one particle over another; the piece returns to its original size and shape in every part when the straining forces are removed. When the piece is strained severely, changes are effected by the sliding of particles over one another. Such sliding not only results in permanent deformation, but causes important changes in structure.

When melted steel with less than 0.9% of carbon cools slowly, the iron solidifies in first one and then another potentially hard and strong form containing carbon in solid solution, like sugar in gelatin, until in the process of solidifying a temperature zone between 700° and 900° C. is reached. While the steel passes through this zone certain important changes occur: (1) The iron expels the carbon and assumes a softer, weaker, pure form, termed alpha; (2) the carbon combines with the iron, forming a hard, strong, brittle substance known as cementite, Fe_3C; (3) the two substances minutely interstratify, in the proportion of six parts of iron to one part of cementite, forming a substance termed pearlite; and (4) the pure iron and pearlite mix intimately and form ordinary steel. The changes at the end of this stage evolve so much heat that the mass brightens in a striking manner—the phenomenon called recalescence.

Grains of Steel Are True Crystals

Steel which is all pearlite contains 0.85% of carbon. Steel contains a somewhat smaller percentage of carbon when its structure shows masses of iron embedded in pearlite. Steel contains a much smaller percentage of carbon when it consists of masses of pearlite embedded in iron; and steel has a greater carbon content than 0.85% when it consists of cementite crystals embedded in pearlite. The converse of each proposition is not always true, but is approximately true for slowly cooled carbon steel.

Iron in its alpha form and other simple metals are shown under the microscope to consist of large numbers of separate grains which differ in size and are irregular in shape. The majority of iron grains vary between 0.0015 and 0.0075 in. in diameter. Much larger crystals have been produced experimentally by slow cooling. Notwithstanding their irregular shapes, the grains which compose the simple metals are true crystals. They have regular planes of cleavage, or slippage, and uniform internal structure. The grains of iron in ordinary steel are similar to those in simple iron, but the pearlite grains consist of alternate layers of iron and cementite, usually between 20,000 and 50,000 to the inch. The structure of these thin layers is crystalline also.

Elasticity (of solids) is the property of returning to original size and shape on removal of stress.

Proportionality of alteration in size and shape under stress is not essential to the conception of perfect elasticity, but in those cases where the elasticity is perfect, and the stress is simple tension or compression, experiments indicate that such proportionality actually exists. When the stress is compound the alteration in length in the direction of any one of the stresses is not the same as it would be under a simple stress in that direction, but if all the stresses are increased or decreased in any given proportion the alterations in size and shape will be in the same proportion. These statements hold within the elastic limits.

Elastic and Plastic Deformation

Carefully conducted experiments on normal specimens of all grades of slagless steel indicate that, at ordinary temperatures, the modulus of elasticity in either tension or compression does not vary much from 30,000,000 lb. per square inch. Wrought iron, doubtless on account of the included slag, has a somewhat lower modulus, and the same is probably true of slag-bearing or weld-steel.

The modulus of elasticity, being determined from specimens composed of millions of grains arranged heterogeneously, is the same in all directions; that is, in respect to its modulus of elasticity, steel is isotropic. Considered from a practical point of view, it is immaterial whether this is due to each grain being isotropic or to the heterogeneous arrangement of the grains.

Straining steel and wrought iron strictly within limits of elasticity is not known to produce any permanent changes in structure. The limits to the elasticity of such metals as steel and wrought iron are closely related to the resistance of such metals to shear. Their deformation when strained beyond their elastic limits is known as plastic deformation.

Such metals as silver, lead, iron and structural steel may be characterized as malleable-ductile. Under pressure, malleable-ductile metals do not, like cast iron, stone and cement, fail by shearing on one or two or a very few planes, but by the successive sliding within grains variously oriented of a multitude of minute crystalline layers one on another in numerous directions inclined to the line of thrust. This causes the grains to flatten and the metal as a whole to spread. Under pull final rupture is preceded by similar sliding which causes the grains to lengthen and the metal as a whole to draw out. In each grain of alpha iron there are at least

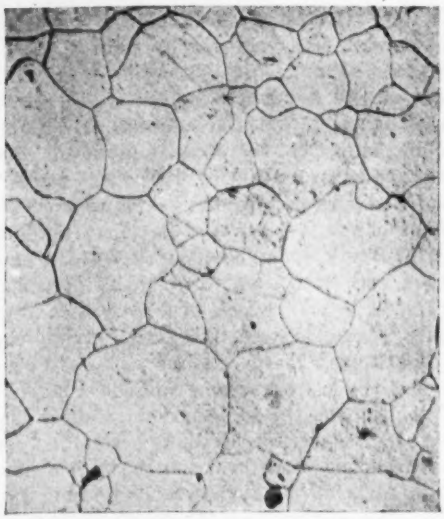


FIG. 1. SWEDISH IRON, MAGNIFIED 150 DIAMETERS

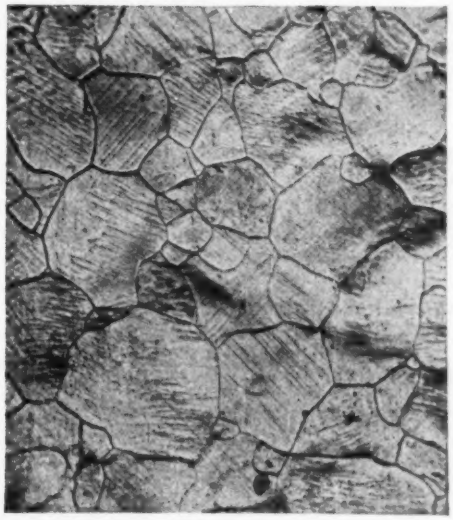


FIG. 2. SLIP BANDS DEVELOPED BY OVERSTRAIN

three directions in which slips can occur when the elastic resistance of the grain is exceeded.

In the sliding over one another of these crystalline layers within the grains of malleable-ductile metals there is usually no break in continuity, as is the case with cast iron, stone and other comminuible materials, but the sliding layers cohere in their new positions.

These facts regarding the crystalline nature of the grains of malleable-ductile metals and the sliding of crystalline layers within the grains when the resistance to shearing is overcome were determined by the English physicists Ewing, Rosenhain and Humfrey by the use f refined and ingenious methods of microscopic research.

In describing the appearance under the microscope of a grain of alpha iron, Ewing has said:

"The main difference produced by the straining is that over the surface of each grain a number of curious black lines have appeared, almost like the crevasses of a glacier, lines which are substantially straight and substantially parallel. It is in virtue of these lines that the plastic strain of the crystal grain has happened. These lines mean not that crevasses are formed, for there is no rupture of continuity, but that there has been shearing at a corresponding number of internal surfaces, that the crystal grain has behaved as a pack of cards behaves when you try to make it alter its form. The pack of cards becomes strained by the slipping of one card on the other, of each layer on its neighbor. In precisely the same way the crystals of metal become strained by the slipping of the little brickbats of one layer on those of the adjacent layer within each grain. The result is that on the polished and etched surface little steps are formed by the slipping, and it is these little steps that constitute the black lines. They are narrow bands rather than lines." Ewing illustrated the formation of these slip bands by photomicrographs, reproduced herewith as Figs. 1 and 2.

When the illumination is perpendicular to the strained

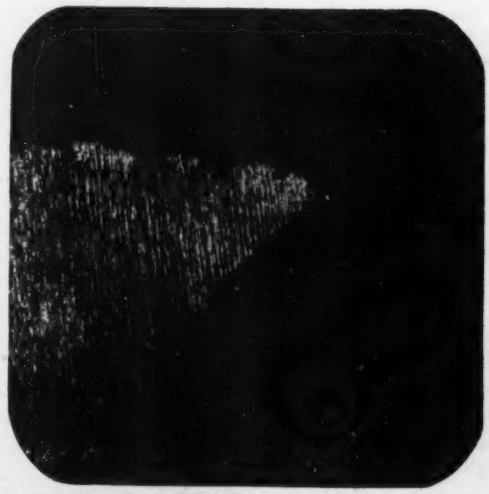


FIG. 3. OBLIQUE LIGHT ON SURFACE OF OVERSTRAINED PIECE OF LEAD SHOWS SLIP BANDS OF ONE GRAIN

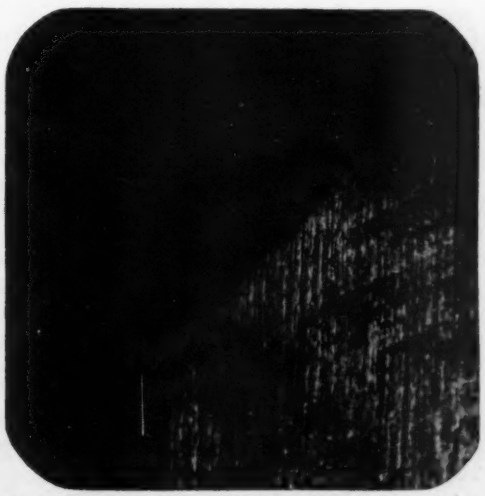


FIG. 4. SAME SURFACE, BUT DIRECTION OF LIGHT CHANGED, PICKING OUT ANOTHER GRAIN (MAGNIFICATION 100)

specimen under microscopical examination the light which falls on those parts of the surface between the places where slip has occurred is reflected up again into the microscope, and these parts accordingly appear bright, but the light which falls upon any one of the little sloping steps is reflected away, and therefore each step appears in the microscope as a narrow dark band. It should be possible, however, by throwing the light from the side and choosing an appropriate direction, to get the little step which was dark in the first instance to shine up brightly. Ewing and Rosenhain tested this theory, and proved that the slip lines are really little steps, by examining and photographing a strained specimen of lead. Two of these photomicrographs are reproduced in Figs. 3 and 4. In Fig. 3 the light is falling on all the grains alike, but only one is visible because none of the slip lines on the others is favorably situated for reflection into the microscope. In Fig. 4 the light has been shifted and another crystal has its slip lines brilliantly illuminated.

In an ordinary specimen test of structural steel the reaching of the elastic limit in a few grains and the consequent slipping within the grains is not appreciable, but when the slipping becomes general it is manifested, in a manner very suggestive of shear, by the breaking of mill scale in inclined lines.

The slipping of the layers of a grain upward and to the right as a result of overstraining is shown in the sketch, Fig. 5, which illustrates the action of the grain

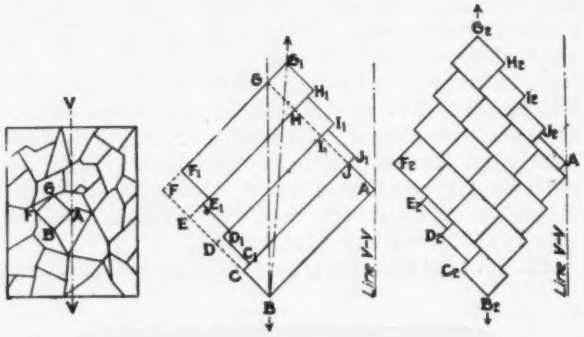


FIG. 5. HOW A GRAIN MAY DISTORT BY SLIP ON PLANES IN TWO DIRECTIONS

ABFG. A second slippage upward and to the left will make offsets in the first slippage planes. Such offsets have been definitely shown in a photomicrograph of a single lead crystal by Ewing (Fig. 6). If the layers simply slipped, the grain as a whole would tip to the right on the first slippage and crowd the neighboring grain adjacent to the line AG, Fig. 5, and would tip back again on the second slippage. When the neighboring grains refuse to have their inclinations disturbed, the slipping layers of a yielding grain have to rotate slightly as they slip. Even under considerable deformation, however, the aggregate angle of rotation of any minute particle is too small to be discerned, the explanation being that the rotation from slips in opposite directions tend to balance.

The slips by which permanent deformation is effected in pearlite grains occur at or close to the surface of contact of the thin cementite and alpha iron layers of which pearlite consists. In the original solidification of the steel, the marshalling of the molecules into parallel crystalline layers was interfered with at the intergranular boundaries, with the result that the structure of the metal between the grains is different from that of the grains, and cohesion between adjacent grains is greater than that between adjacent crystalline layers of the same grain. In subsequent plastic deformation, the slippage within the grains of alpha iron and the grains of pearlite necessarily causes some disturbance at the intergranular boundaries, but the movement is effected with as little disturbance as possible.

In a piece of steel which has been permanently deformed to a small degree, the grains occupy the same relative position. The crystalline particles bounded by planes of slippage within the grains have undergone no radical change, and the deformation is simply due to the changed relative positions of these crystalline particles; but a remarkable transformation has been effected in very thin films of metal between adjacent crystalline particles. These films, as the result of the shear or sliding action produced by the forces which deformed the grain, have changed from solid to liquid, or to the equivalent of liquid.

Before the films of metal resolidify after being made mobile by shear, the metal as a whole is in condition intermediary between solid and liquid, and possesses in some degree the characteristics of both states.

Liquids have no static resistance to shear. Cohesion without static resistance to shear does not prevent but does impede the flowing. This property is termed viscosity. Viscous liquids not only have cohesion, but to a greater or less extent have the property of adhering to solids. This useful property, this glue-like stickiness, though not essential to the scientific conception of viscosity or included in the scientific definition of the term, is firmly ingrained—in fact predominates—in the popular idea of the meaning of the word.

According to some physicists, the plastic solid is distinguished from the viscous liquid in that the former requires a certain magnitude of stress to be exceeded to make it flow; whereas the viscous liquid will yield to the slightest stress, but requires a certain length of time for the effect to be appreciable. This distinction is generally accepted, although it is superficial.

The change from a solid to a liquid state is a radical one. Considerable energy, usually in the form of heat, is required to melt the solid. This energy is not expended in raising temperature, but in effecting molecular changes by reason of which the potential resistance to flowing is overcome and the molecules are less restricted and have greater freedom of action. It is this difference in molecular arrangement, no matter how produced, which is the real distinction between a liquid and a solid.

H. E. Tresca, by applying great pressure, caused copper, silver, iron, and other metals to flow, like viscous liquids, through a small circular aperture. Parallel experiments, with layers of dough or sand plus some connecting material, proved that the particles moved along the same tracks as would be followed by a flowing cylinder of liquid.

A certain portion of malleable-ductile metal, when caused to flow by "a certain magnitude of stress," is a highly viscous liquid during the continuance of the flow, and even for a time after the removal of the stress.

While the very sticky mobile or liquid metal in thin films between the solid crystalline layers of the grains holds these layers together, it permits them to slide one over the other under force.

The theory that mobile films are formed in metals at all internal surfaces of slip was suggested by G. T. Beilby after he had discovered that the operation of polishing metals formed a true non-crystalline skin over the polished surface. The formation of this non-crystalline skin is an unmistakable sign that it has passed through a state in which it must have possessed the perfect mobility of a liquid.

The development of mobile or liquid films oetween the sliding surfaces prevents the development of any appreciable sliding friction, and leaves the viscosity of the film the sole resistance to shear. From this and the additional fact that the maximum shear occurs in a plane making an angle of 45° with the direction of a simple tension or compression, it can be readily shown that the quantity which expresses the elastic limit in terms of shear intensity is one-half the quantity which, in cases of simple tension or compression, expresses the intensity of the tension or compression at the moment the elastic limit is reached. For instance, if the elastic limit for a certain quality of steel has been definitely found by tension tests, and appears to be 36,000 lb. per square inch in tension, it really is 18,000 lb. per square inch in shear.

Accordingly, ordinary steel, with not more than 0.85% of carbon, when fairly free from hard, brittle grains and from initial stresses, has the same elastic limit in compression as in tension. By similar reasoning, it should have the same elastic resistance to direct shear produced by torsion—and to the shearing component of compound stresses—as to the shearing component of simple tension. This is borne out by some experiments on tubes and is a safe assumption, but other experiments on thick tubes and solid sections appear to indicate a greater elastic resistance to shear in the cases of torsion and compound stresses. The appearance of greater resistance is probably due to the fact that the first slippage occurred only near the extreme fiber and was so slight that it was not detected. When deformation was first noticed the real elastic limit had doubtless been passed.

A film of steel which has been made mobile or liquid by stressing it beyond its elastic limit is liquid at a temperature far below its freezing point, and, on the removal of the stress which made and kept it liquid, resolidifies with great rapidity into a form much harder and stronger than that which it possessed originally. Accordingly to Beilby it is then amorphous, not crystallized even in the minutest particles. It would seem that the resolidification is so rapid that crystals do not have time to form. In solidifying, such liquid films cement the adjacent crystalline layers of the grains and thus transform what had been the planes of easiest slip into those of greatest resistance, so that to effect plastic deformation a second time more force is required. In other words, by the resolidification the elastic limit in the direction of the original straining is raised.

These statements as to the structure and strength of resolidified steel do not apply to all malleable-ductile metals. For instance, in lead, according to Ewing, even at atmospheric temperatures severe overstraining is followed by a protracted crystalline growth which results in the formation of relatively large crystals. Lead, however, has a freezing point much lower than iron or steel.

After a load which had strained a piece of steel beyond its elastic limit—thus liquefying thin films between crystalline layers—is removed, the liquid films tend to resolidify almost instantly, and would do so were it not for the force to which they are subjected from the elastic solid portion of the steel. The elastic solid portion endeavors to resume its former size and shape,

FIG. 6. TWO SETS OF SLIP BANDS IN A STRAINED PIECE OF LEAD (MAGNIFICATION 1000 DIAMETERS)

and would do so instantly were it not for the opposition of the viscous liquid which adheres to it and is compelled thereby to flow, but which refuses to flow rapidly. As a consequence, the viscous portion is for a while subjected to a push or pull from the elastic solid portion, the return of which to its former size and shape is thus delayed until the intensity of the force acting on the liquid films is reduced to a point which permits complete solidification.

Much of the recovery after overstrain takes place in a few minutes, and nearly all in a few hours; but the process becomes exceedingly slow toward the very end, and may continue for many days. The recovery after overstrain, as appears from experiments by J. Muir, may be greatly hastened by mild heating. He found that pieces of medium steel, which normally required a long rest to regain equilibrium at atmospheric temperature after being overstrained in tension, recovered in a few minutes when exposed to the temperature of boiling water.

The raising of the elastic limit in tension or compression by the plastic deformation and resolidification of steel is frequently accompanied by some lowering of the elastic limit of resistance to the opposite kind of stress; but this is in spite of and not in consequence of the resolidification and is due, there is good reason to believe, to a shifting of the elastic field by the modification of balanced internal stress. This phenomenon, which is highly important as regards the resistance of steel after overstrain, is reserved for future consideration.

The raising of the elastic limit by overstraining is of

great benefit in fabricating and using structural steel and wrought iron. It also gives to drawn wire, drawn steel and cold-rolled steel their enhanced strength. It is essential, however, that the overstraining should not be too great.

Harmful Effects of Fatigue

True fatigue is the temporary impairment of elasticity and strength incident to the development by stress and continued existence for a limited period of thin films of viscous metal. In some cases the metal is permanently injured by overstrain, and some authorities give the name fatigue to this permanent injury.

Straining metals beyond their elastic limit and thus causing them to flow tends to create minute interstices between solid elements. These interstices have to be filled with viscous metal to act as cement or there will be cavities and cracks. If iron or steel is not very ductile, so that only a small portion becomes viscous under high-stress-intensity, or if it is ductile but so overstrained that the viscous portion will not fill the interstices, the overstraining will develop permanent cavities and cracks which nothing but heating will remedy. In fact, iron and steel can be strained, even when at welding heat, to such an extent that flaws are developed which nothing short of remelting can remedy.

Permanent cracks may also be developed by alternate stresses, which at first cause no cracks but only slips, occurring at such frequent intervals that the liquid films developed with the slips are kept in constant motion back and forth and eventually solidify without cementing the adjacent crystalline surfaces.

Blow-holes, foreign substances (such as sulphide of iron and graphite) and cavities and cracks caused by overstraining while cold or hot, break the continuity of the metal and thereby weaken it. Probably no steel or iron is free from such flaws, and Andrews has shown micro-flaws to be very numerous. These breaks in the continuity of the metal cause the stress to be concentrated at their edges. It is at these flaws and at scratches and other injuries on the surface that cracks are most liable to develop.

When a piece of steel or iron is subjected to repeated tension or compression from zero to about or beyond its primary elastic limit, or to alternate tension and compression in amounts somewhat less than the primary elastic limit, or to cycles of stress of greater range and intensity, slip lines appear and some become cracks. One or another of the cracks spreads to other grains and develops across the piece to complete fracture without much preliminary deformation. In such a fracture the crystalline nature of the metal is not disguised by a preliminary drawing out of the grains, as is the case in ordinary pulling tests. Instead, the crystalline nature of the metal is evident; and the cleavage sometimes develops in a continuous plane through two or more adjacent grains, which increases the size of some of the bright crystalline surfaces that make up the fracture and thus exaggerates the apparent size of the crystals.

The difference in appearance between the fractures in ordinary pulling tests and those caused by alternating stresses has given rise to the extensively held but mistaken idea that alternating stresses cause steel and iron to become crystalline. Actually, the metal is crystalline from the beginning.

The recovery of iron and steel from fatigue—which makes possible some of the processes of manufacture and fabrication—the high elastic limit given to those metals by overstraining them, as illustrated in the case of drawn wire, and their failure under frequent repetitions or reversals of stress, lose much of their mystery when considered in the light of the modern discoveries of the effects of strain on the structure of iron and steel. Some phenomena, however, such as permanent sets under low loads, failure under reversals of stress of seemingly low intensity, and the shifting of the elastic field to suit the conditions of loading, cannot be explained without taking into account the influence of balanced internal stresses.

Motor Truck Tonnage Increases 131 Per Cent in Ten Months

Censuses Taken on Cleveland-Akron Highway Show the Great Value of This Type of Transportation

A TRAFFIC census recently taken on the Cleveland-Akron highway shows an immense increase in the use of motor trucks for the 10-month period which ended Mar. 24, 1918. This census, compared with a similar one taken in May, 1917, gives an approximate estimate, it is said, of the value of this form of transportation, not only as a war measure but also as a factor in the future development of the country's commerce. In this time, the tonnage increased 131%, the number of freight and passenger cars released by it was 1315, or at the rate of 68,380 per year, and it may be concluded that if such conditions prevailed throughout the country the transportation shortage would be practically relieved. A very material increase in the use of tonnage capacity, which is such an important item from an economic standpoint, is also shown.

Three sources of information were available for this study. First, a census taken during the three-day period from 6 p.m. May 18 to 6 p.m. May 21, 1917, by the National Paving Brick Manufacturing Association and reported in *Engineering News-Record* of Aug. 16, 1917, p. 316. This census was expanded to the period of one week and tabulated; the table is given herewith. Since May 20, 1917, was Sunday, it is probable that the passenger traffic shown is slightly more than the average, while the freight traffic shown would be somewhat less. Second, a census was taken for the week of Mar. 18-24, 1918, inclusive, by J. A. Meacham and W. H. Peterjohn, of the Case School of Applied Science. This is also shown in one of the tables. Third, the total freight

TRAFFIC CENSUS, CLEVELAND-AKRON HIGHWAY, MAY, 1917

Truck Capacity, Tons	Condition	No. Loaded	No. Empty	Tonnage	Total Vehicles	Tonnage Possible
Over 5 Ave. 8½	Loaded	26	...	221	26	221
	Empty	...	42	...	42	357
5	Loaded	224	...	1,120	224	1,120
	Empty	...	105	...	105	525
3	Loaded	135	...	405	135	405
	Empty	...	110	...	110	330
1½	Loaded	224	...	336	224	336
	Empty	...	317	...	317	476
Totals,		609	574	2,082	1,183	
Passenger motor vehicles					21,247	
Horse-drawn		117	329	...	446	
Grand totals				2,082	22,876	3,770

TRAFFIC CENSUS OF CLEVELAND-AKRON HIGHWAY TAKEN IN MARCH, 1918

Truck Capacity Tons	Condition	Direction of Traffic: Akron to Kent No.	Akron to Kent No.	Akron to Kent Tons	Kent to Akron No.	Kent to Akron No.	Kent to Akron Tons	Cleveland to Kent No.	Cleveland to Kent No.	Cleveland to Kent Tons	Kent to Cleveland No.	Kent to Cleveland No.	Kent to Cleveland Tons	Cleveland to Akron No.	Cleveland to Akron No.	Cleveland to Akron Tons	Akron to Cleveland No.	Akron to Cleveland No.	Akron to Cleveland Tons	Total Loaded	Total Empty	Ton'ge Car'd	Ton'ge Possible
5	Loaded	55		275	37		185	41		205	22		110	235		1,175	223		1,115	613		3,065	3,065
	Empty		17			25			9			16			50			62			179		895
3	Loaded	119		357	31		93	42		126	10		30	162		486	66		198	430		1,290	1,290
	Empty		27			43			19			28			43			56			216		648
1½	Loaded	80		120	46		69	28		42	18		27	72		108	62		93	306		459	459
	Empty		91			85			26			16			54			78			350		525
	Sep'rate	254	135		114	153		111	54		50	60		469	147		351	196		1,349	745		
Totals				752			347			373			167			1,769			1,406			4,814	6,882
	Comb'd		389			267			165			110			616			547			2,094		
Passenger motor cars			2,458			2,152			1,621			690			2,210			2,065			11,196		
Horse-drawn vehicles			162			113			79			91			126			114			685		
Grand totals			3,009			2,532			1,865			891			2,952			2,726			13,975	4,814	6,882

traffic of the three railroads between Cleveland and Akron was supplied by officials of the roads.

Referring to the census tabulations, it will be seen that the total number of vehicles passing over the road in the week of May 18, 1917, was 22,876, while the total number of motor trucks was 1183. The percentage of motor trucks to the total traffic was therefore 5.2. For the similar period in 1918 the total number of vehicles was 13,975, while the number of motor trucks was 2094, and the percentage of motor trucks to the total traffic was 15. The tables show that the weekly total traffic in the 1917 census period was considerably greater than was in that of 1918. This is explained by the fact that the census for the latter was taken in March, while that for the former was taken in May. As would be expected the tables show much greater passenger vehicle traffic in May than in March, there being only 11,196 in March as against 21,247 in May of the preceding year. In the same period, while the total traffic showed a decrease, the increase in the number of motor trucks used was 77 per cent.

Increase in Tonnage Is Even More Striking

The tonnage increase is even more striking, probably due to the more efficient use of the trucks. In 1917 the total freight carried for the week was 2082 tons, while in 1918 the total was 4814 tons, or an increase of 131%. The tonnage efficiency, as shown by the tables for the respective years, is interesting. The total tonnage of freight that might have been carried in 1917 was 3770 tons. The actual amount hauled was 2082 tons, and if we divide the latter by the former the efficiency was 55%. In the same way, the total freight capacity in 1918 was 6882 tons, while the amount handled was 4814 tons, and the tonnage efficiency was 70 per cent.

While the census of 1916 was being taken 471 new trucks went over the road under their own power. Many of them were empty, no doubt, but as no data were available as to their loads, no attention was paid to them in obtaining the 70% efficiency mentioned above. If many of these were empty, it is self-evident that the tonnage efficiency of the used trucks would show an even greater increase.

Motor Truck Freight Exceeds Shipments on Two Railroads

Another item brought out by the investigation was the amount of freight being transported over the highway, as compared with the amount carried by rail. There are three railroads between the two cities, but the bulk of the freight is carried by one road. In fact, it was ascertained that the freight shipped by motor trucks exceeded the total shipments of two of the railroads by 97.8%. The total amount of freight carried by the railroads between Cleveland and Akron, during the 1918 census, was 4870 tons. From the table for 1918 the amounts carried from Cleveland to Akron and Akron to Cleveland were, respectively, 1769 tons and 1406 tons, a total of 3175. In other words, about 40% of all the freight carried directly between the two cities was carried by the highway.

1091 Freight Cars Released

The value of such a highway to the community is thus seen to be great. The freight carried in one week, 4814 tons, divided by 27.1 tons, the average amount per car as given by the Railway War Board, shows 178 cars to have been released to other uses. Adding to this the fact that 1354 new automobiles and 471 new trucks which would ordinarily have been shipped by rail, went over the road under their own power, and assuming that two units, on an average, could be loaded on a freight car, a further saving of 913 cars is indicated. In all, this would amount to a release of 1091 freight cars for other purposes.

In the above discussion no notice is taken of the fact that 11,196 passenger motor vehicles passed over the road, and if we assume that there was an average of two passengers to each car, or 22,392, and that on the average 100 persons would ride per railway coach, we can add to the above saving 224 coaches released for troop transportation.

It is about 40 miles from Cleveland to Akron, and for most of the distance between the two cities the highway is paved with brick.

London to See American Timbers

Samples of American woods and wood products are to be displayed at the rooms of the Royal Institute of British Architects, in London, as the result of the action of John R. Walker, United States trade commissioner, in bringing the advantages of these timbers to the attention of the Institute. The exhibit will be arranged by associations affiliated with the National Lumber Manufacturers' Associations, in coöperation with the United States Bureau of Foreign and Domestic Commerce.

Advisory Council to Co-ordinate Post-War Readjustment

Should Assist Reconstruction Commission and Bring Together All Governmental Activities That Will Affect Future Industrial Relations in America and Abroad—Names Suggested for Such Council

By Wingrove Bathon
Washington Representative, Engineering News-Record

An outline of a suggested Presidential readjustment and reconstruction commission, to deal in this country now with problems that will present themselves after the war, was presented in these columns last week (p. 1031.) It was suggested that such a commission, appointed by an executive order of the President of the United States, with a personnel selected from leaders in private American industrial effort, should have the assistance of an advisory council, also appointed by executive order, whose members should be selected from executive officials of the Government and legislators.

Such an advisory council should be selected from those who are especially charged with the conduct of affairs vital to the industrial, commercial, financial, transportation, labor and educational worlds. Realizing the demands made by the war on the chief cabinet officers, it should not be expected that they should serve actively on such a council, although in one or two cases, such as that of William P. G. Harding, the governor of the Federal Reserve Board, principal officials, rather than those second in command, ought to be selected. In the case of legislators, many chairmen of Senate and House committees are also too much occupied with war legislation to deal now with after-the-war problems. Officials of executive department holding places on such an advisory council should be charged not only with the duty of giving advice and outlining governmental policies of the present and possible policies of the future, but should detail experts in their own departments to the service of the commission. In the list below, strict order of precedence and rank in the Government is not followed, but such an advisory commission or council should include the following:

Frank Lyon Polk, counsellor for the Department of State, for all international contact.

F. M. Simmons, chairman of the Senate Committee on Finance, for contact with future Government revenues and taxes.

Claude Kitchin, chairman of the House Ways and Means Committee, future Government revenues and taxes.

Duncan U. Fletcher, chairman of the Senate Committee on Commerce, legislation affecting commerce.

Thetus W. Sims, chairman of the House Committee on Interstate and Foreign Commerce, legislation affecting commerce.

Gilbert M. Hitchcock, chairman of the Senate Committee on Foreign Relations, future international legislation.

Henry D. Flood, chairman of the House Committee on Foreign Affairs, future international legislation.

John Bassett Moore, vice-chairman, United States section, International High Commission, international law, patents, trademarks, etc., in Latin America.

John Barrett, director general, Pan American Union, for Latin American contact in detail.

William P. G. Harding, governor of the Federal Reserve Board; and Charles S. Hamlin, president of the Capital Issues Committee; and Sherman Allen, treasurer of the War Finance Corporation, for contact with finance.

E. R. Stettinius, assistant secretary of war, for contact in industrial war production; and Rear Admiral Samuel McGowan, paymaster general of the Navy, industrial naval production.

Maj. Gen. E. H. Crowder, provost marshal general, reintroducing returned soldiers to industry.

William H. Taft and Frank P. Walsh, chairmen, War Labor Board, war labor problems and activities.

John A. McIlhenny, president, Civil Service Commission, Government employment.

Carl Vrooman, assistant secretary of agriculture, the soil and its agricultural products.

Edwin F. Sweet, assistant secretary of commerce, the census and other bureaus dealing with commerce.

William B. Colver, chairman of the Federal Trade Commission, the coming administration of the Webb Act which permits combinations for foreign trade; and for contact with unfair practices under the Newlands Act.

F. W. Taussig, chairman, United States Tariff Commission, material now being gathered by the commission on after-the-war problems.

Raymond B. Stevens, vice chairman, United States Shipping Board, tonnage available after the war.

Herbert C. Hoover, United States food administrator, food licenses during reconstruction period and possible repeal of laws.

H. A. Garfield, United States fuel administrator, distribution of coal and oil and possible repeal of laws during and after reconstruction period.

Walker D. Hines, assistant to the director general of railroads, transportation and terminals after the war.

A. Mitchell Palmer, alien property custodian of the United States, final disposition of the enemy-owned plants and other property.

Bernard M. Baruch, chairman of the War Industries Board, sources of supply of raw materials and finished products.

Walter S. Gifford, director of the Council of National Defense, reviving less essential industries.

Vance C. McCormick, chairman, War Trade Board, licenses for imports and exports after the war.

Executive Secretary (when named) of the Water Power Commission of cabinet officers which is about to be created.

Daniel C. Roper, commissioner of internal revenue, collection of excess profits taxes, etc.

Charles D. Walcott, president, National Academy of Sciences, for Government contact with the sciences.

Charles F. Nesbit, Division of Military and Naval Insurance, personal insurance problems and defectives on his rolls who are returned soldiers.

Philander P. Claxton, commissioner of education and secretary of the Federal Board for Vocational Education, educational statistics and statistics on defectives.

George Creel, chairman, Committee on Public Information, for assistance and contact with educational work.

It is respectfully submitted that this is no mere list of names. Broadly speaking, it is an analysis of the industrial war organization of the United States, and a reading of the suggested contacts will show that the work of these officials, and that of their departments, bureaus and associates, will be just as vital to the solving of after-the-war problems as it is vital to winning the war now. The two problems can not be separated. All national contacts today are international. We think and move in terms of world-wide importance.

What We May Have To Do

After four years of war, England has found it necessary to tear up and move to France between 15 and 20% of her main-line tracks. If the war goes on a long time, if there is not steel enough, if there is not labor enough, if there is not constant maintenance, something like that might happen in this country. Then there will be need for actual physical reconstruction in this country, as there is abroad, instead of need merely for readjustment. Plans for such possibilities must be made now. Again, it is estimated that we shall have within a year from 45,000,000 to 50,000,000 tons of steel ingot producing capacity and probably 100% greater finishing machine producing capacity than we had in 1913, in which year we were obliged in many lines to go abroad for a market for our surplus production. What plans are in the making for our surplus production after the war? Again, it is estimated that we shall have, with what we now have, 15,000,000 tons of merchant ships available after the war. What definite trade routes from American ports to the other ports of the world are being thought out?

The biggest American businesses which have been built up abroad have been in machine finished steel products, such as talking machines and music machines, cash registers, agriculture machinery, adding machines, sewing machines, etc. Plans must be made to reintroduce these special products and extend the market for them.

One company now represented in Washington desires to open an office in Rio de Janeiro; another desires to send 600,000 tons of shipping to Australia next year. Is there any governmental or semi-governmental agency in Washington to offer encouragement or authoritative advice? No.

What is being done to divert to American ports the rehandling business previously done in Europe, such as the bringing of rice from India to reclean it, regrade it and reship it? What is being done to hold for the United States the rubber now coming here, to avoid two trips through the submarine zone, which formerly went to England? What is being done to hold for the United States the business in tin which formerly went to England and Holland from Bolivia? What is being done to hold for the United States the business in coffee which originally went almost entirely to Europe, at which time we paid for the longer freight haul and commissions in London, Hamburg and Bremen, and much of which now comes to this country?

An advisory council such as has been outlined in this article, working with the proposed Presidential readjustment and reconstruction committee or commission, could answer these questions, if answers are in existence; and if not, could through the commission place industry in a position to meet such problems as have been suggested and a thousand more. The United States Tariff Commission is one of the few governmental agencies which is avowedly gathering data for after-the-war problems. The Federal Trade Commission, the Department of Commerce and the War Trade Board are also collating some information. But there is no apparent coördination of these efforts, such as there is in England and other countries.

Overhead Structures a Feature of Latest Electrification

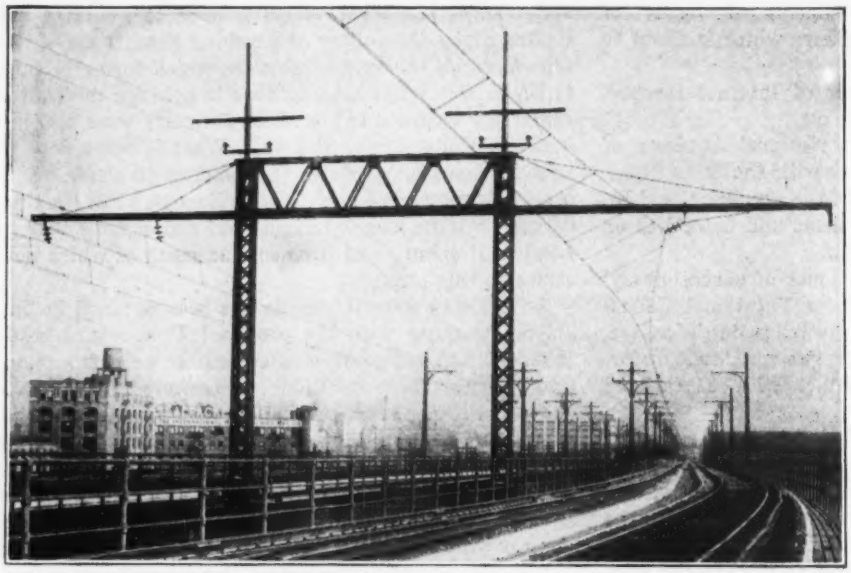
Curves and Viaducts of New York Connecting Railroad, and Heavy Power Ordered, Necessitate Special Construction

SUBSTANTIAL and in some cases special structures have been erected to carry the overhead system of the electrified New York Connecting R. R. These were made necessary in part by the high power of the locomotives, and in part by the numerous curves, bridges and viaducts on the line.

Data regarding the operating conditions of the New York Connecting R. R., and the electric locomotives ordered, were presented in March before the New York Railroad Club by E. R. Hill, of Gibbs & Hill, who had charge of the electrification, and some of these data were published in *Engineering News-Record* of Mar. 21, p. 553. Five 180-ton electric locomotives—50% heavier than those now operating on the New York, New Haven & Hartford R. R. between New York and New Haven—have been ordered. They will operate with both the 11,000-volt overhead system of the New Haven and the 600-volt third-rail system of the Pennsylvania, making continuous operation possible between the Pennsylvania Station in New York and New Haven. With their greater weight and power they will handle full passenger trains up the grades of the connecting railroad, which are considerably in excess of those of the New Haven.

Most of the line will be operated under the 11,000-volt overhead system of the New Haven R. R. The freight tracks are not electrified, except for pusher service up the bridge grades, and the freight service is conducted over the Long Island R. R., under steam operation, to Bay Ridge.

While in general the standard overhead construction



SPECIAL BRIDGE AND BRACKET CONSTRUCTION, PORT MORRIS APPROACH

of the New Haven was followed, in detail there are a number of differences. There are also a number of points of similarity between the new construction and that of the Pennsylvania in Philadelphia.

Wherever there is opportunity for guying, pole construction, either with cross spans or brackets, is employed. The poles are set 6 ft. deep in concrete foundations about 3½ ft. square, extending a foot more or less below the bottom of the pole. The pole height from the rail surface to the point of attachment of the guys is about 35½ ft. The guys are 1½ in. rods attached to the poles by means of collars, provided with turnbuckles for adjustment, anchored firmly in reinforced-concrete blocks which are set not less than 8 ft. below the ground surface and are protected from the anchors to points above the ground by means of 3-in. boiler tube.

The pole top is occupied by the following attachments: Just above the guy rod, or clamp, is a short crossarm made of two angle irons placed back to back, which carries the 220-volt signal feeders on pin-type insulators. Above this is a longer crossarm, not yet occupied, which is designed to carry four high-voltage wires to be used as trolley feeders. Projecting from the top of the pole is a rod which carries at its upper end, a distance of 8 ft. above the upper crossarm, a ½-in. galvanized ground wire.

The pole top described is standard along the line, even on the four-track structural bridges, which are fitted on each side with tubular bonnet poles cemented into the structural posts.

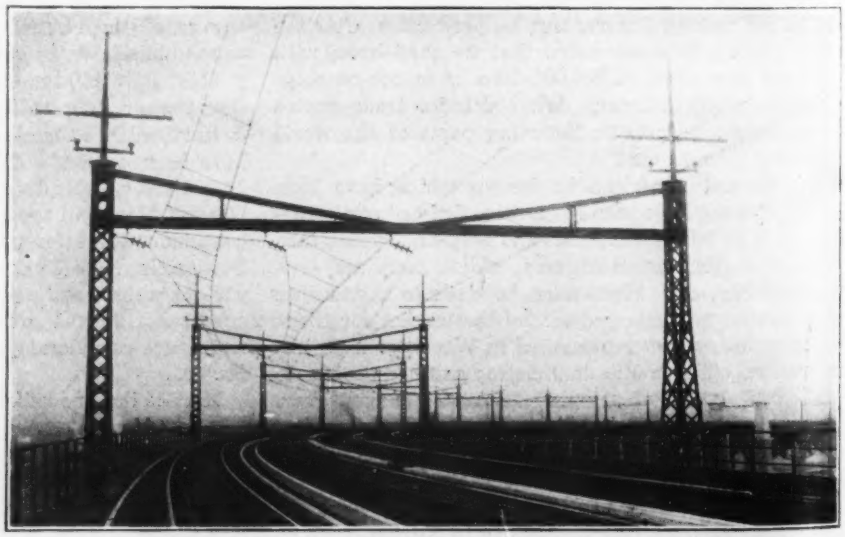
In the standard bracket construction the angles are formed of angles or channels placed back to back. The single-track bracket is attached to the pole by a simple band, the weight being supported by one sag rod. In the longer brackets two sag rods are employed.

Where guying is not possible, channel cross structures with sag braces, or in some cases latticed bridges, are used. In some places these are supported from steel poles, but in general latticed poles well spread along the line of the track are employed. Where the feet of these lattice poles span expansion joints, they are rigidly supported on but one side, the other foot resting upon a plate upon which it can slide, bolts in slotted holes being used to prevent overturning. As these lattice poles are necessarily supported outside of the bridge girders, their weight is carried on two substantial steel brackets each, riveted securely to the outside girders of the viaduct.

Within the Hell Gate Bridge the contact wires are supported by cross wires attached to the steel members of the bridge. At either end of the Little Hell Gate bridge towers are used to support a crossbeam for carrying the contact wires. One of these is also used as a safety anchor for these wires. On the Bronx Kill bridge the contact wire insulators are attached directly to overhead steel members with safety anchors at each end.

The catenary construction follows the New Haven standards.

For the purpose of railroad communication a telegraph and telephone conduit line was built connecting with the



OVERHEAD SYSTEM ON THREE-DEGREE CURVE, WARD'S ISLAND VIADUCT

Pennsylvania R. R. at Sunnyside yards and the New Haven Railroad at East 132d St. On the viaduct the conduit line consists of six fiber ducts protected by concrete heavily reinforced and provided with steel splicing chambers. In the fill south of the viaduct a six-day underground conduit line was constructed of vitrified clay ducts incased in concrete. The standard manhole is of precast oval, reinforced-concrete type, with concrete covers.

In general the conduit line is located between the tracks. On account of the many expansion joints, made necessary by the presence of the numerous viaduct girders, the construction of the conduit is somewhat unusual.

At the joints the conduit is ended off square with several inches of space between adjacent ends, and the gap is covered over with sheet iron bent to clamp the conduits tightly.

Russia Needs Extensive Municipal Improvements

Utilities Broken Down—Opportunities for Telephone and Electric Service, Gas Works, Water-Works and Sewerage—Virgin Field for Civil Engineer

By Sterling H. Bunnell
Chief Engineer, R. Martens & Co., Inc., New York City

READING the news of riot, bloodshed and anarchy in the cities of Russia, it seems visionary to discuss the needs of those cities in tramways, electric light and power, gas, water and, most of all, street pavements. Yet these needs are urgent, and the inhabitants of the cities are fully aware of the fact, and willing to do whatever is required to obtain the improvements they want. It is true that in Russia for the moment the whole system of collecting revenue and doing business is disorganized, so that contracts cannot be made; but this unfortunate condition is by no means permanent, and will end rather suddenly whenever the sane majority succeed in enforcing their rule over the impractical talkers who promise everything but can perform nothing.

Russia has been called a nation more Asiatic than European. It is indeed different in many ways from the countries of Western Europe. It has few closely-built cities, but a large number of enormous villages with populations up to 50,000 or more, living in wooden houses set along unpaved roadways. These towns have no municipal improvements whatever. The only sewers are open channels under plank sidewalks. The streets are mostly unlighted, and the roadways are rutted with crooked wheel tracks in places, and grass grows in others. The town dwellers are often rich peasant farmers whose lands lie in scattered fields outside of the settlement, so that the owner has to walk or drive a considerable distance from home to reach the location of his day's work. Along with the farming population there are, of course, merchants, shop-keepers and trade-workers, making up a self-supporting community.

German Penetration

Before the present war the Germans in their process of commercial penetration of other countries purchased properties in some few of the larger cities of Russia and took a hand in improving the cities along modern lines. They built modern hotels, like the best in western Europe, opened department stores, and built factories, generally dependent on German raw materials. As their interests expanded they induced local capital to join in building central stations for electric light and power, gas-works, street railways, water-works and sewers. Several Russian cities were so modernized as to appear to visitors to be more German than Russian. In all this work German standards were followed. More than this, the Russian authorities were so carefully instructed that they came to believe that only the particular devices introduced could be satisfactorily used. Repairs and extensions thus naturally were ordered in Germany until the outbreak of the war, and since then no orders have been placed because the Russians have no confidence in the manufactures of nations other than Germany. As a single instance of this, electric current meters for household service are badly wanted in many cities, but the local ordinances even yet require the use of a type obtainable only from German manufacturers. It has been observed with wonder in England that no air raids have been made over such important Russian cities as Petrograd; but in Russia the reason is believed to be the predominance of German capital in the industries of those cities and the willingness of the devil to take care of his own.

Scanty and Neglected Municipal Works

The present condition of municipal improvements in Russia is deplorable. The street-car service has perhaps suffered most of all. It has been impossible to provide new rails, so all trackage is in bad shape. The population of the larger cities has been doubled by the presence of refugees from invaded portions of Russian territory, so that houses are overcrowded and an enormous overload is thrown on city industries. Street cars began breaking down long ago, and were kept in repair with difficulty. When the revolution broke out and discipline was destroyed, the soldiers stationed in the cities, who always ride free, took to joy-riding all over town, overloading the cars by hanging onto every available projection of car body or truck that might possibly support a hand or foot. Receipts accordingly fell off, and cars broke down in all directions. In Moscow, for instance, it was estimated in July last that 60% of the passengers carried paid no fares; and the cars in service had broken bits of fenders dragging along the ground, steps broken off, platforms sagging loose, and were generally in dangerous condition. In August affairs had become so bad that half the already insufficient service was with-

drawn in what we would call the "nonrush hours;" all night cars were taken off, and the service on some lines was reduced throughout. The same conditions exist in Petrograd and in all other cities of Russia where there are tramways, so that there must be a heavy expenditure for repairs at the earliest possible moment when shipments can be delivered. Some orders for new equipment, placed before the Russian revolution, are as yet unfilled from lack of ship space as well as difficulty in carrying out the contract terms of payment.

Telephone and Electric Service

Telephone service is considerably used in Russia, though to far less extent than in America. The convenient one-hand receiver and transmitter is common; but the ringer is often built in an open frame of cast-iron, and must stand on a table or desk, more or less in the way. The exchange service is naturally bad, and growing worse along with the progressive disorganization of all employment. Extensions and new installations are quite unobtainable in most cities, owing to lack of material and instruments. Business in Russia is already conducted with the aid of the telephone as in other countries, so that the need for extensions increases all the time. There will undoubtedly be large sales of telephone equipment as soon as terms can be arranged.

Central electric power and lighting stations are established in the larger cities only. Some projected installations were held up by the war, generally because the equipment was ordered in Germany. Some machinery has been reordered from Sweden, but little has been done to increase the generation and use of electricity since the war began. There is room for much development in this direction. Unfortunately, the production of coal in Russia and Siberia has always been inadequate to the needs of the country, and much wood is burned for power purposes as well as for domestic use. There is, however, plenty of coal on the ground, and railway lines adequate to distribute it are likely to be among the first projects to be carried out. Water-power is lacking over a large part of Russian territory because of the flat, level nature of the land, but in the southern portion there are streams which can be utilized for power purposes. Several concessions have been granted and various plans have been worked out for large hydro-electric plants to supply current to industries over considerable areas of country, but all these await the end of the war before contracts can be let and work commenced.

Gas-Works Opportunities

Gas manufacture and distribution offers a large field for development. In the larger cities there are many families living in apartments in large buildings, generally without even central heating, and this class of habitation would be greatly improved by the general provision of gas for cooking and heating. The tall brick or tiled stove built into the division wall of two or three rooms is the usual heating system. Wood fires must be built in every stove early in the morning of every winter day, using heavy sticks so that the fire may last until the mass of brickwork is thoroughly heated. The samovar must be fired up with charcoal two or three times a day. Cooking is done on ranges built of brick, and with wood fires. Hot water for bathrooms, where these exist, is usually supplied by a small heater with wood fire. Gas for domestic use in city dwellings would add greatly to comfort, effect important economies, and bring in large revenue. There are any number of cities and towns which could support lare gas-works but at present depend on wood and oil only.

Water-Works and Sewers Needed

The water-supply of Russian cities is generally inadequate and of poor quality, though there are exceptions to this. Many cities and large towns depend on dug wells, always dangerous as a source of supply in settled country. Many large towns are situated on rivers which are the great highways of Russia and Siberia, and thus have abundance of water at hand. Filtration is always necessary, and in that climate filters should be of the covered type. Pumping engines, water piping, standpipes, meters, hydrants, fire-extinguishing apparatus and plumbing equipment will be used in enormous quantities in bringing Russian cities to the standards of western Europe.

Sewer systems in Russia are nonexistent or extremely primitive. The common method is to carry the sewage in open channels or ditches under the plank sidewalks. Cesspools, open sewers and shallow wells for water-supply make a most objectionable and dangerous combination in many of the great villages which have long ago outgrown a safe size for village conditions. The development of proper sewerage systems for Russian cities will include sewage-disposal plants, for generally it will not be permissible to discharge untreated sewage into the rivers. The work has hardly been touched as yet, and so offers the attractive condition of a clean sheet of paper for the design, with no old and unsatisfactory fragments to be avoided or worked into the new scheme.

Virgin Field for the Civil Engineer

There is probably no country in all the world that offers such opportunity for a civil engineer to do his best work unhindered by the mistakes and faults of others before him. Not one, but a hundred big towns are ready for his choice of a site for his labors, and each needs tramways, gas, electricity, sewers and water-works. In their unpaved streets the underground work can be located to the best advantage, conduits and manholes can be arranged, street surfaces properly graded, and pavement, curbing and sidewalks put in to stay undisturbed by the necessity of laying some new system beneath. German engineers tried their skill with good effect on several Russian cities which today owe their modern attractiveness to the pushing Teuton commercial penetrator. It is to be hoped that American engineers will take an important part in working out the improvement plans of other Russian cities when the time comes.

The one difficulty in sight is the problem of financing the work. In the flood of new projects which followed the first days of the Russian revolution, various cities decided on expenditures for improvements far beyond their possible resources. Since then the failure of the Russians to organize a government and provide for financing the needs of the country has brought about

an astonishing condition in which a nation possessing a great population and a country of enormous natural resources is totally unable to provide its people with the barest necessities of life. Obviously, the condition is artificial, brought about by the total disregard or ignorance of the laws of commerce and industry. For that reason the condition will change as soon as the Russians find leaders who are capable of understanding and acting under those laws. It is impossible to forecast when such leaders will appear, though it is safe to say that the time is not likely to be long delayed. But as plans must be made before money is needed for carrying them out, any who may be interested in the coming development of Russian cities can hardly begin too soon on the necessary preliminary investigation and study.

Oregon-Washington Railway Separates Grades for Three Miles at Portland

Track Depression, Lowering Summit in Railroad Profile, Is Combined with Elevation of Street Approaches—Seven Bridges Required, Mainly I-Beam Structures with Concrete Decks

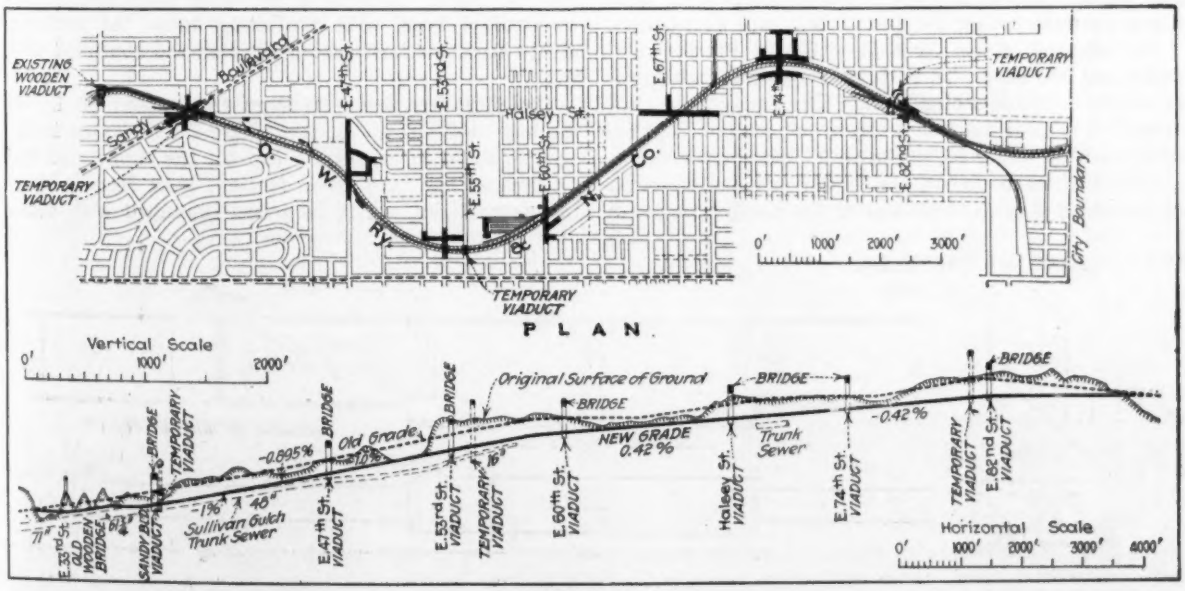
TRACK depression combined with raising of street elevation for bridges over the tracks was the method adopted for the elimination of grade crossings at Portland, Ore., on the line of the Oregon-Washington Railway & Navigation Co. (Union Pacific System). The railway is located in a depression known as Sullivan Gulch, which traverses a residence district at the east side of the city. The work involved lowering the railway for a distance of about 3½ miles and constructing seven street bridges.

The improvement was decided upon in 1915, when the city council declared nine grade crossings to be dangerous and directed the city engineer to prepare plans for their removal. These plans were filed in July, 1916. Depression of the tracks seemed the logical method, as the railway had a summit at the east end of the work, with a descending grade through the district affected. Its profile has been improved, therefore, by the cutting down of the summit. The line has been lowered an average depth of 12 ft., and has grades of 0.42 to 1%. The streets crossing the tracks are raised about 14 ft. at the bridges in order to give the required clear headway of 22 ft. above top of rail. No grades exceeding 5% are used on the bridge approaches.

A four-track railway on a roadbed 100 ft. wide, forming the bottom of a cut with sodded slopes, is provided for in the plans. The cut as now made is for two tracks only, and has a bottom width of 34 ft. At the bridges, however, the material is excavated for the full width between abutments.

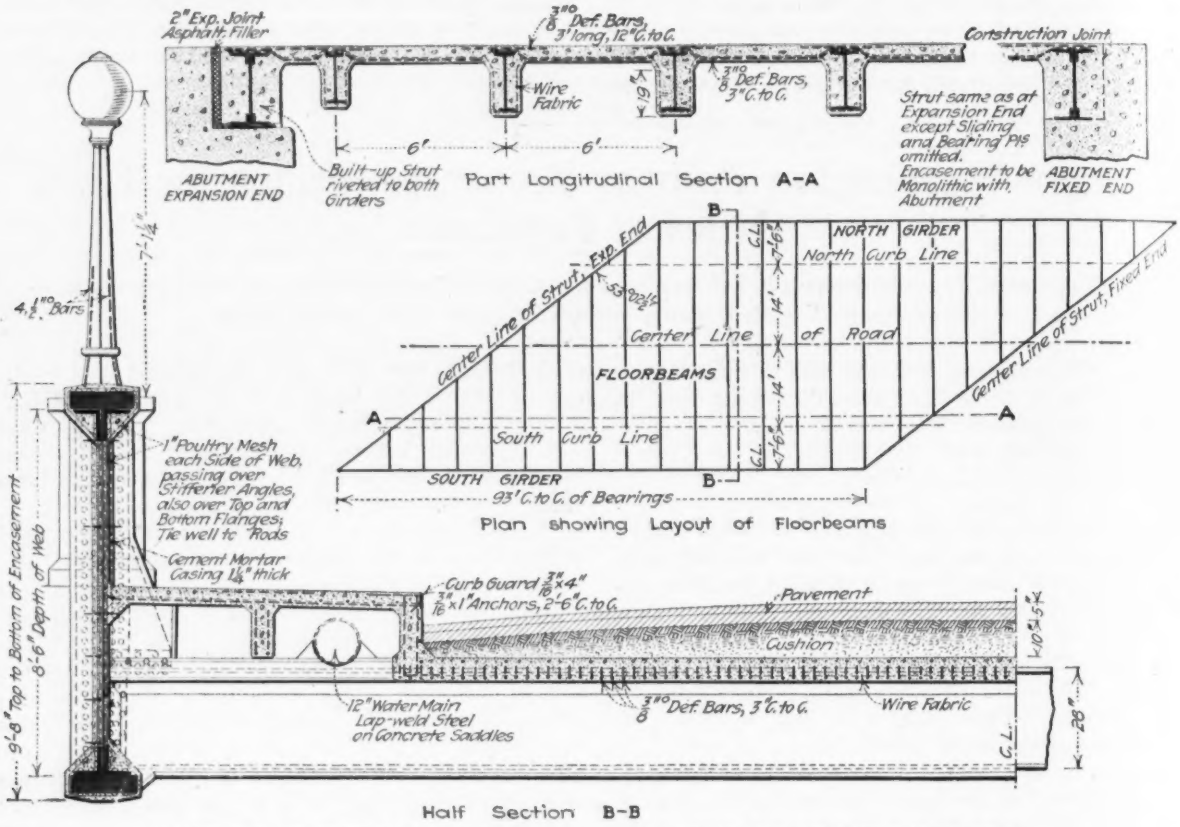
While the street layout is mainly rectangular, the railway has a circuitous location through the district. With the skew crossings thus caused it has been practicable to make one bridge serve two or more adjacent streets by means of inclined approaches. The seven new bridges are in addition to an existing timber viaduct which has been rebuilt. Some streets were either closed or connected to other streets leading to the bridge approaches.

Six of the bridges have I-beam spans with reinforced-concrete deck slabs, the I-beams being designed to carry all stresses without assistance from the slab. All steel-



TRACK DEPRESSION METHOD FOLLOWED IN GRADE-SEPARATION PROJECT SHOWS ON PLAN AND PROFILE

work is incased in concrete. The spans are supported on concrete abutments and two intermediate concrete piers. The middle span crosses two tracks and each side span provides for a single track, except that where bridge. This is 80 ft. wide, however, while all the others are 50 ft. wide, and it is the only one carrying a street-car line. The normal clear width between the faces of the abutments is 55 ft., and the two piers are


2" Exp. Joint Asphaltic Filler
⅜" Def. Bars, 3' long, 12" C. to C.
Construction Joint
Wire Fabric
⅜" Def. Bars, 3" C. to C.
Strut same as at Expansion End except Sliding and Bearing Pls. omitted. Encasement to be Monolithic with Abutment
ABUTMENT EXPANSION END
Built-up Strut riveted to both Girders
6'
6'
Part Longitudinal Section A-A
ABUTMENT FIXED END
4 ½" Bars
1" Poultry Mesh each Side of Web, passing over Stiffener Angles, also over Top and Bottom Flanges; Tie well to Rods
Cement Mortar Casing 1¼" thick
9'-8" Top to Bottom of Encasement
8'-6" Depth of Web
B
NORTH GIRDER
North Curb Line
Center Line of Strut, Exp. End
Center Line of Road
FLOORBEAMS
Center Line of Strut, Fixed End
A
South Curb Line
SOUTH GIRDER
93' C. to C. of Bearings
Plan showing Layout of Floorbeams
Curb Guard ⅜" × 4"
⅜" × 1" Anchors, 2'-6" C. to C.
Pavement
Cushion
12" Water Main Lap-weld Steel on Concrete Saddles
⅜" Def. Bars, 3" C. to C.
Wire Fabric
G.L.
Half Section B-B

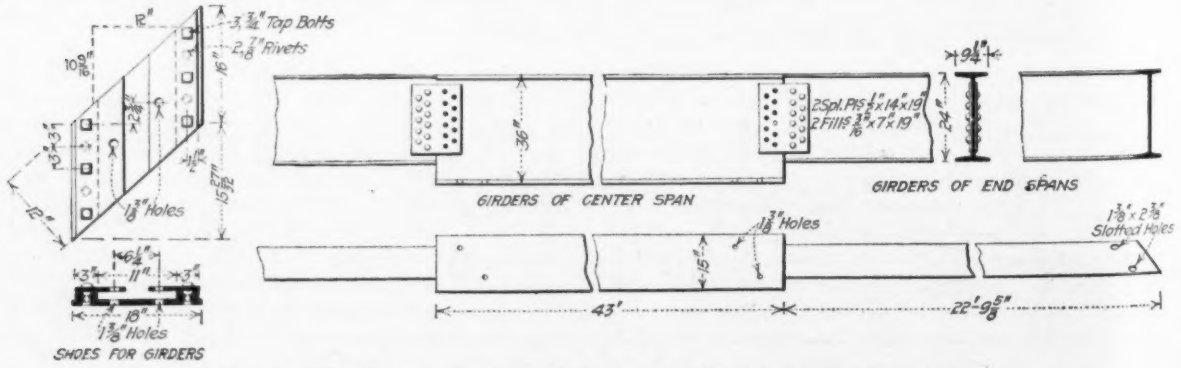
HALSEY ST. BRIDGE HAS PLATE GIRDERS WITH I-BEAM AND CONCRETE SLAB DECK

an additional industry track is provided the side span crosses two tracks. The seventh bridge has a single plate-girder span of 93 ft. on a skew of about 53°. This has a concrete casing for the girders and floor-beams.

For all bridges the live load is 150 lb. for the sidewalks and 300 lb. per sq.ft. for the roadway, with provision for a 20-ton motor truck. The Sandy Boulevard bridge also provides for a train of electric locomotives, each weighing 93,000 lb. on a 21-ft. wheelbase.

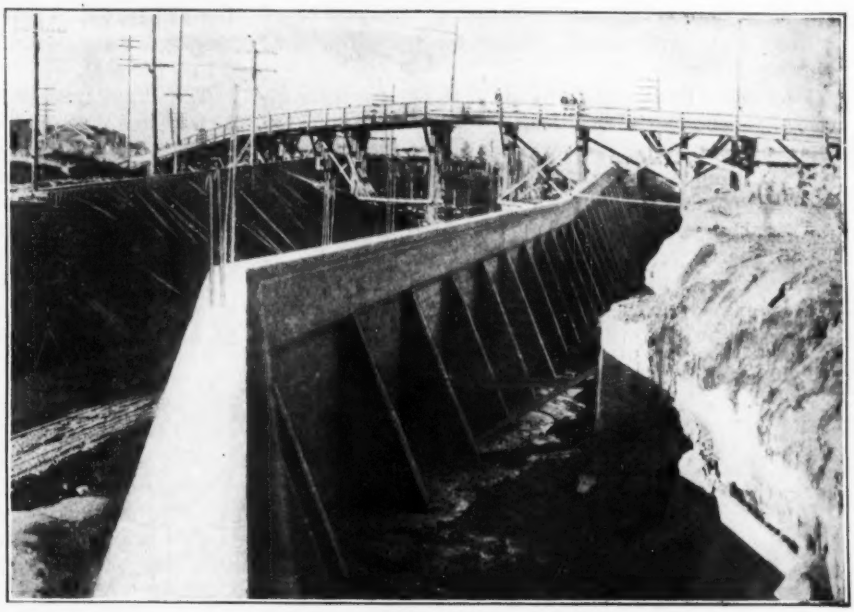
Typical construction of the I-beam bridges is shown in the accompanying drawings of the Sandy Boulevard spaced 31 ft. on centers. The wing walls of the abutments extend back to the right-of-way lines, which are 100 ft. apart. Abutments and wing walls are of the counterfort type, with projecting toes. At corners, struts are sometimes placed between the abutment and wing.

The piers are walls tapering from about 36 in. at the base to 24 in. at the top, where the thickness is increased to 36 in. to form a cap for the support of the I-beams. They have broad footings built directly upon the natural soil, which is gravel combined with some



I-BEAM GIRDERS OF SANDY BOULEVARD BRIDGE AT PORTLAND, OREGON

clay and has a bearing capacity of more than 3 tons per square foot. No foundation piles were required. The steelwork consists of 17 lines of Bethlehem I-beams, these being 30-in. beams for the middle span and 24-in. beams for the side spans. The three beams of each set are in line, with their tops in the same plane, and their webs are spliced so as to form a continuous girder over the three spans. The spacing between the beams varies from 9½ ft. under the sidewalks to 6 ft. 3 in. and 4 ft. under the roadway, the closest spacing being at the middle, to provide for the load on the car tracks. In the other bridges, which carry no tracks, the I-beams are lighter and the spacing is from 3 ft. at the middle to 5 ft. 9 in. at the sidewalks.



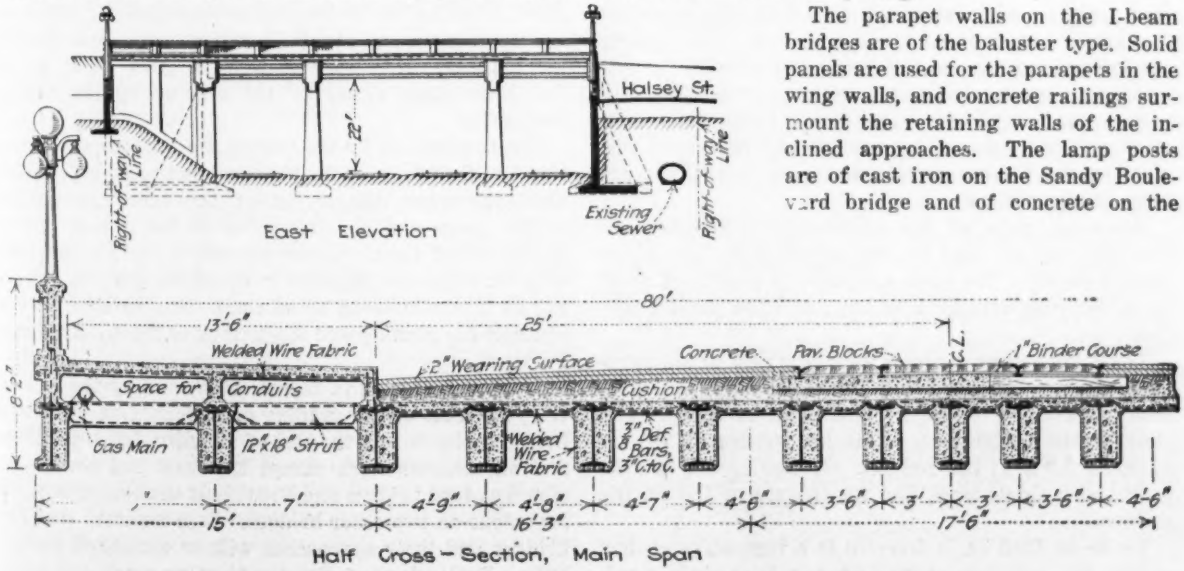
BUILDING RETAINING WALLS AND ABUTMENTS FOR BRIDGE AT SANDY BOULEVARD —TEMPORARY VIADUCT CARRIES ELECTRIC TRACK AND SIDEWALK

A 5½-in. reinforced-concrete slab forms the deck and the tops of the I-beams are embedded in this. Directly over the beams are short transverse bars, near the top of the slab. In the bottom of the slab is a sheet of welded wire fabric, which is bent up to pass over the top flanges of the beams. The sidewalks are 5½-in. slabs carried by the curbs and by concrete joists on top of the I-beams. Reinforced-concrete struts between the sidewalk beams give the necessary lateral stability and serve also to support the public utility pipes and conduits laid beneath the sidewalk.

Two methods of incasing the steel I-beams, to protect them from rust and corrosion, were permitted by the specifications. The plan adopted was to use forms for a concrete casing of practically rectangular section, formed monolithically with the deck slab, and reinforced by a trough of steel-wire fabric. The other plan was to use the cement gun to apply a coating on the parts of the I-beams exposed beneath the deck slab.

Resilience in the pavement is provided by a cushion bed laid upon the concrete deck. Its top is shaped to the contour of the roadway, so that it is 7 in. thick at the curbs and 13 in. at the center. This bed is composed of 15% pine or fir shavings saturated in hot creosote, 40% pulverized clay, and 45% fine sand. Upon this is a 5-in. bituminous paving having a 3-in. base course and 2-in. wearing surface. The Sandy Boulevard bridge has sandstone block paving between the rails and tracks. The electric railway company built the tracks, which have 6-in. 97-lb. grooved girder rails on wood ties laid on the cushion bed, with concrete between and over them as a base for the paving.

The parapet walls on the I-beam bridges are of the baluster type. Solid panels are used for the parapets in the wing walls, and concrete railings surmount the retaining walls of the inclined approaches. The lamp posts are of cast iron on the Sandy Boulevard bridge and of concrete on the



Half Cross-Section, Main Span

SANDY BOULEVARD BRIDGE HAS I-BEAM SPANS AND CONCRETE DECK

other bridges. Exposed surfaces of concrete were rubbed with carborundum blocks for the purpose of removing form marks.

Decorative treatment in addition to the parapets includes paneling of the concrete facia girders, with the name of each street in depressed letters in the center panels. Simple ornamentation is found also on the ends of the piers.

Two plate girders 93 ft. long and 8½ ft. deep, spaced 50 ft. apart, form the single span of the bridge at Halsey St., which is the one that crosses the tracks on a skew of 53.6°. The floor system of this bridge consists of 28-in. Bethlehem I-beams spaced 6 ft. apart and resting on the bottom flanges of the girders. Owing to the skew of the crossing, the ends of the girders are connected by 28-in. plate-girder struts, against which are framed the ends of the short floor-beams. The deck is a 6½-in. concrete slab, with reinforcement, cushion and paving as already described. The I-beams are incased in concrete, this being poured with the deck slab and forming beams of rectangular section. Cement-mortar casing on the girders is applied over wire mesh and is reinforced by vertical and horizontal rods on the webs, the horizontal rods being carried through holes in the stiffeners.

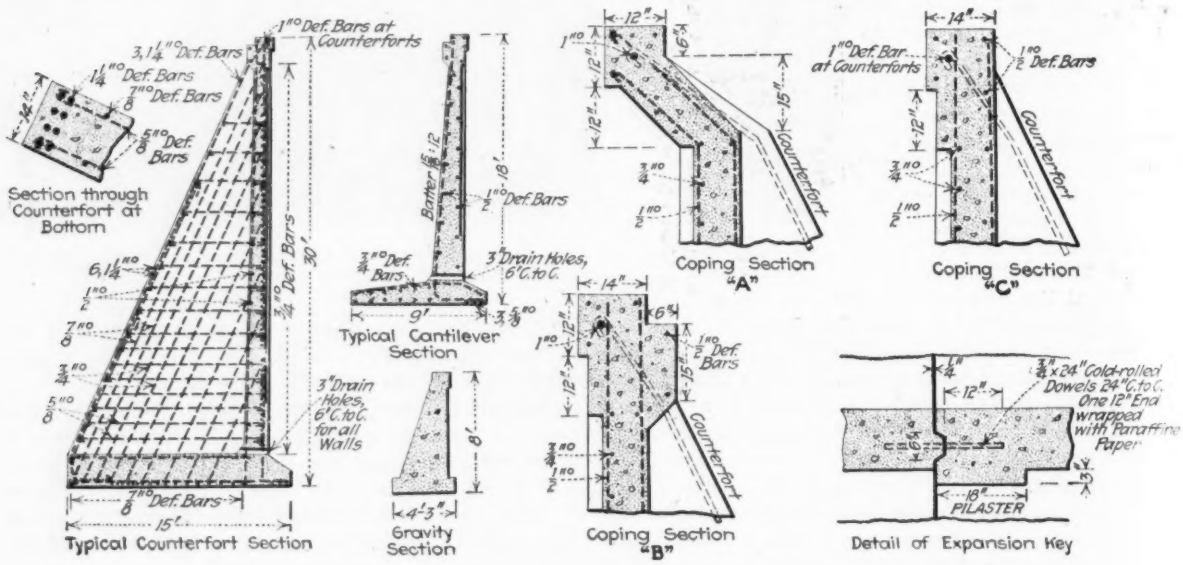
Retaining walls of the cantilever, counterfort and gravity types are used for the approach inclines of the several streets. The walls are made in lengths of about 60 ft. between expansion joints, and have paneled surfaces.

Three temporary viaducts were provided to accommodate street traffic. At Sandy Boulevard a 700-ft. trestle built on a curve forms a run-around to carry traffic clear of the bridge site. This has grades of 7% reduced to 3.3% at the summit. It carries only a sidewalk and a single-track line for the use of the electric railway.

Traffic on 53rd St. is diverted to a temporary viaduct at 55th St., and that on 82nd St. to a long viaduct ending at 81st St. These are trestles with a 17½-ft. roadway and 6-ft. sidewalk, and have approach grades of 6 to 8 per cent.

The three trestles have framed bents, and the two latter have each a 40-ft. truss span over the railway tracks. These highway viaducts were designed to carry a live load of 200 lb. per sq.ft. An existing 250-ft. timber trestle viaduct at 33rd St. was removed to make way for the railway excavation, and then rebuilt at the lower grade of the street over the new cut.

Changes in water mains and sewers had to be made at several streets. The 30-in. water main in E. 60th St. had to be relaid at the new elevation before the railway grading was begun, to provide against interruption of water-supply. For this a subway was built in tunnel, lined with concrete slabs. The largest sewer affected was the Sullivan Gulch trunk sewer, 16 to 71 in. in diameter. This had to be lowered at some points. Most of the water-main and sewer alterations were done during the grading. Necessary changes in other public utilities were made either by the city or by the utility companies.



DIFFERENT TYPES OF RETAINING WALLS USED IN CONSTRUCTION OF BRIDGE

The contract let by the city to the Pearson Construction Co., Seattle, calls for the construction of all bridges and approaches, the laying of the necessary public-utility mains and the excavation of the railway prism within street lines. Under the city's charter the railway company was required to do all the work of lowering its tracks between street lines. The railway let the contract for grading and track work to Twohy Brothers, Portland.

Work was started in March, 1917, and by the end of the year most of the grading and foundation work had been completed. At the end of January, 1918, the steel and all concrete work except the deck had been completed at four bridges and about half the concreting had been done on two other bridges. It is expected that the bridges and their approaches will be completed during 1918. Particulars of the construction work and some

other details will be given in a later issue of *Engineering News-Record.*

The estimated cost of the city's part of the work is $594,000. Of this, $518,650 is for the bridges, approaches and other construction work; $47,530 for land and damages, and $28,320 for engineering and superintendence. This last item is 5% of the cost for construction and land. The cost of the railway work was about $295,000, making the entire cost a grand total of $889,000.

Plans and specifications for the work were prepared and contracts let in 1916 under Robert G. Dieck, commissioner of public works, by Philip H. Dater, city engineer. George S. Edmonstone, chief of design and construction, was in direct charge. Since the change of administration early in 1917 the work has been handled under A. L. Barbur, commissioner of public works, by O. Laurgaard, city engineer. R. E. Kremers, chief of the bureau of highways and bridges, is in direct charge of the construction. The railway work is under the supervision of S. Murray, chief engineer of the Oregon-Washington Railway & Navigation Co. (Union Pacific System), with A. C. O'Neal (succeeding A. F. Marion) as engineer in direct charge.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

To Publish Service Records of Members

In the forthcoming directory of the American Association of Engineers there will be an innovation in the way of a classified list, separated into the several branches and specialties of engineers. Thus, under the electrical engineering division will be sub-heads of members who have had experience in the design, inspection, test or sales of batteries. In the base or main list, which will be alphabetical, regardless of grade, the full service record will be given, so that the directory becomes a guide to the employer of engineers and a silent salesman for the individual, to the end that quicker service may be rendered to both parties in fitting square pegs in square holes.

Chicago Engineers Discuss Rapid Transit Policies

Franchise questions and administrative problems of municipalities, though often considered outside the field of the engineer, are subjects in which engineers and engineering societies should take definite and practical interest. At a recent meeting of the Western Society of Engineers the developments in the Chicago local transportation problem since 1897, and the present negotiations aiming at more adequate service, were reviewed by George Weston, chief engineer of the Board of Supervising Engineers, which has charge of traction affairs. He submitted the results of his study as preliminary to future reviews in which the developments may be recorded from time to time, in the society's publications.

Feeling that engineers should be a focus wherein to concentrate exact information for their layman acquaintances, the young men's committee of the society spent two evenings with Mr. Weston previous to his presentation of the subject to the entire society. He was asked to outline the problem in a popular way, to answer popular objections and to explain the political aspects of the question. The Chicago traction situation is complicated, and the aim of the discussion was the bringing out of the important points, so that the engineers would be able to talk intelligently on these problems and help to guide public opinion on this civic question.

Talk It Over—and Out

Service to the individual by the enginering society depends in large measure upon how much the individual puts into the society. A record of the kind of reciprocal service rendered, how much and how effective it is, is one of the reasons for this column. Prof. A. N. Talbot, president of the American Society of Civil Engineers, speaking before the Associated Engineering Societies of St. Louis, put the matter tersely as follows:

"What functions relating to service to its members should be assumed by an engineering society it is difficult to say. The service of library and publications, the opportunity to meet engineers and extend acquaintanceship and to learn about men is freely given. But it is believed by many that some needs of members, especially of the younger men, have not been well handled by the societies. Probably this is true, but how to do these other things has not been told.

"An engineering society cannot use trades-union methods. Complaint is made about the compensation of engineers. Probably the older men are fairly well compensated. The young man is not badly off—he is serving an apprenticeship and drawing a salary. The man who has been at work ten years or more may not be so well situated, and in some fields it is probable that he is underpaid. What can be done? First, recognize the conditions as existing. Both the engineer and the public are responsible. Discuss the problem and work it out. It seems possible that some new organization using some of the methods of the trades union may undertake to regulate pay and conditions of work. That this will best serve the purposes of the profession is a question which is worth discussing.

"Although we may take pride in the accomplishments of the engineering societies the membership must not rest on past achievement. We must hold to the proven good, ancient though it may seem, but our eyes must be kept open for progress that the society may accomplish the most for the profession and the public. What may best be done to extend the usefulness of the engineering society is an important problem for the societies."

These introspective comments were made early this year, and we are seeing already the fruits of Professor Talbot's influence in the advanced steps and open-minded way in which the Engineering Council, one of

the most potent agents in the hands of the great national organization, is "recognizing conditions as they exist" and getting first hand at the pulse of the profession from the rank and file up to those at the top. The speaking tour to the Middle West recently made by A. D. Flinn, secretary of the Engineering Council, can mean nothing else than an intensive effort to find out the needs and build up the machinery to meet them.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

City Engineers and War Gardens

Sir—One field for patriotic activity that is open to the city engineer is the war garden. He knows what lots are available for cultivation. His office and field force is capable of performing the clerical and rough survey work necessary to the allotting and staking of the lots. His position renders it easy for him to obtain the use of vacant lots and, being a city official, the public feels more free to avail itself of his services.

In Utica 520 war garden permits were issued last year and, in spite of the exceedingly wet season, the results were gratifying. Our work resulted not only in the cultivation of these gardens, under committee auspices, but of countless other gardens as well. It served to show to many persons that even a small piece of ground could produce food; and it served, also, to develop the idea of gardening, which, it is expected, will not pass with the close of the war.

JOSEPH KEMPER,
Utica, N. Y. City Engineer.

Sprinklers of Equal Value as Construction in Kansas City Fire

Sir—Automatic sprinkler production was as much a factor as fire-resistant construction in arresting the progress of the conflagration in the wholesale and warehouse district of the West Bottoms, Kansas City, Mo., Apr. 4, although this would not be gathered from the article, "Conflagration Stopped by Fire-Resistant Buildings," in the May 16 issue of *Engineering News-Record*. The full facts in the case may be learned from the report on the fire by the Missouri Inspection Bureau.

The conflagration was stopped in its southwesterly progress by the C. A. Murdock Manufacturing Co.'s building, five stories high with walls of brick and floors of boards on joists, and the Kansas Moline Plow Co.'s warehouse, a 7-story building of brick walls and wooden floors of semi-mill construction. Concerning the effect of automatic sprinkler protection in the Murdock building the report says: "This building was in the direct path of the fire on the south side of Union Ave., the building adjoining was of the same height and the flames sweeping over the parapet set fire to the roof. The fact that the building was sprinklered stopped the fire at this point and served as protection to property beyond."

About the efficacy of the sprinkler protection in the Kansas Moline Plow Co.'s building the report says: "This building * * * was directly exposed by the burning buildings at 40 ft. and * * * at 30 ft. Wired glass windows directly exposed stood up well under fire but were badly damaged; ordinary glass windows diagonally exposed did not stand up under fire and were badly damaged. The sprinkler system operated, about 26 heads being opened, and did good service in preventing the spread of the fire to the interior of the building."

The progress of the fire to the east was stopped by the Ridenour-Baker building, of reinforced concrete and sprinklered, but what the Missouri Inspection Bureau's report says about this building does not support the contention that fire-resistant construction alone served to stop the progress of the fire. The report reads, in part:

"The building was in the direct path of the fire and severely exposed. The intense heat melted out the wired glass windows protecting openings in the east wall and opened sprinkler heads in the east division, and although the fire doors in the division wall beyond operated, the fire also communicated through large wired glass windows in the south wall of the west division, a total of 265 heads in both divisions being opened. The south wall was also protected by open sprinklers into which the water supply was turned on a short time after the fire was discovered, thus forming a water curtain which rendered excellent service in preventing the fire from making progress and communicating into the interior of the building. It seems probable that if this building had not been equipped with a sprinkler system the fire would have gone through it and left nothing but a concrete shell. It also served in a measure as a fire stop and protection to property beyond."

The article also refers to the Brokers' Warehouse and Storage Co's building of reinforced-concrete construction as an example of the conflagration stopping powers of fire-resistant construction. The Missouri Inspection Bureau's report has this to say about what happened in this building:

"The west wall was exposed within 80 ft. by the burning buildings across Santa Fé St. and practically all the windows were burned out or badly damaged. The sprinkler system operated, about 30 heads being opened, and did good service in preventing the fire from spreading to the interior building, the heads on the first line of sprinklers forming a partial wall curtain. It seems probable that if this building had not been equipped with a sprinkler system the fire would have gone through it, leaving only a concrete shell, and would probably have also spread to the long row of old buildings on the north side of Union Ave. beyond."

In a general reference to the sprinklered buildings involved in the fire the report says: "Four sprinklered buildings were involved and directly exposed in the fire. Sprinklers were undoubtedly an aid to the fire department in preventing the spread of the fire to other buildings. The low pressure in the city mains caused the secondary water supply from * * * tanks to come into service * * *; the private supplies through sprinklers preventing the fire from making progress in the buildings protected."

Of course, fire-resistant construction played a part, and a very valuable one, in arresting the progress of this fire, but by no means the exclusive part asserted by your correspondent. One of "the lessons to be learned from this fire," says the Missouri Inspection Bureau report, is "the value of a fireproof and sprinklered building as a fire barrier."

NATIONAL AUTOMATIC SPRINKLER ASSOCIATION,
New York City. IRA G. HOAGLAND, Secretary.

Their Third City Manager

Sir—In the interest of the profession I am sending a clipping from a mid-western daily, with names deleted for obvious reasons.

A commission-manager city charter became effective Jan. 1, 1915. The first manager was a municipal engineer from a nearby town and was paid about half what a city of such size should and normally does pay. The commission "business men" insisted on doing the detail work. The "manager" was little more than a clerk. In about three months a scapegoat was needed.

The second manager was selected for his record as a belligerent. He came from a larger city with commission-manager government, was a thoroughly trained engineer, an excellent executive, experienced in nearly all branches of city affairs. He was paid adequately, took his work seriously, and gave an excellent administration. His only fault, if it be one, was a tendency to lavish expenditure for improvements that were not strictly necessary. He grew to be too able for the city and went to a larger one.

The third and present manager is the hold-over city engineer from the administration that preceded the commission-manager plan. He is an able "business" man and is well liked.

The candidate for water superintendent referred to in the clipping is also a hold over from the old city government. He has come up from the ranks, is a good executive on maintenance work, is well liked by his men, who work well for him. Unfortunately, he is handicapped by lack of education and narrowness of experience (20 years in one town) and is inadequate for the job of correlating the new work that is in progress to enlarge the water-supply. The factory-hand and retired-farmer voters do not appreciate breadth of experience and cannot be told.

SUBSCRIBER FOR TWENTY-EIGHT YEARS.

[The gist of the whole story told in the clipping is an argument in favor of appointing as superintendent of water-works a "practical" local man who has been in the water department for 20 years, rather than go outside the city for an engineer. The second city manager and the superintendent of water-works who is just leaving for a better position, "both men of unquestioned ability, had to work under handicaps" from which local men would have been free, the argument runs. It is said that "professional experts in administrative capacities" are not looked on with favor in the city. They are "here today and gone tomorrow," to more important positions. True, the story runs, an experienced engineer is needed just now to look after projected improvements to the water-works, and the local man proposed for the position lacks technical training, but an engineer can be called in to make good this man's deficiencies, thus adding "technical skill" to "practical ability." The local man has always lived in the city, owns property and, like "our boys" generally, should receive a chance to "make good."

Local sentiment and practical politics of this sort must be reckoned with, however unreasonable it may seem to those whose primary interest is efficient city administration. "Peripatetic municipal experts" should take notice—and move on to larger opportunities when the value of their services becomes more highly appreciated in other communities than in those they are serving.—Editor.]

An Appreciation and Some Suggestions

Sir—I desire to thank the one who compiled my article in your issue of ———. It was a great improvement over the original manuscript. Writing is a trade, like everything else. Some of my old roughneck friends in the Northwest, when they read that article, will wonder what is wrong. I can hear some say, "Well, he may write that way, but damned if he talks like it!"

I generally read the letters to the editor first. The improvements in engineering are in the little things, line upon line, precept upon precept, etc. The engineer is not a writer, but he will tell his story in letter form, say in three or four hundred words. It seems to me that this feature will stand enlarging upon in your paper, and as variety is the spice of even a technical journal, little matters of side interest to engineers are very readable and are appreciated.

I note in past numbers some complaint that engineers are too narrow—that they have a 2 x 4 outlook on the world. Well, this is true. About 75% of the profession have a smattering of mathematics, a little miscellaneous junk known as engineering, something about baseball and pool. A few of the old-timers knew more about the Barbary Coast than they did about bridge designing. (I say "a few," as we want to let them down easy, in remembrance of many rathskellar nights in the dim but alas, not forgotten, past.) To make up for some of these lost years, when we were doing our bit in an effort to make Milwaukee famous, would it be possible for *Engineering News-Record* to run one good article every month on some state, federal or international subject—something right up to the minute, and written exclusively for engineers? If we are to be city managers and leaders, we would like a few pointers on history, politics, biography, all written for a special purpose. It would help us to get on the right track.

ENGINEER.

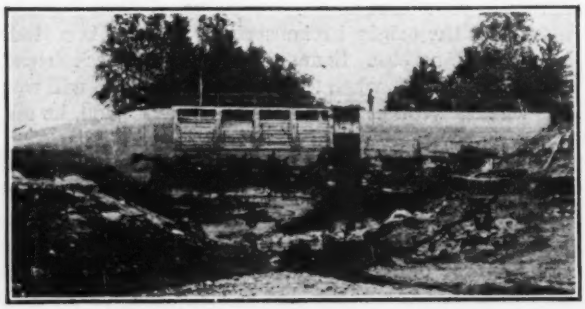
Compulsory School Ventilation Proposed

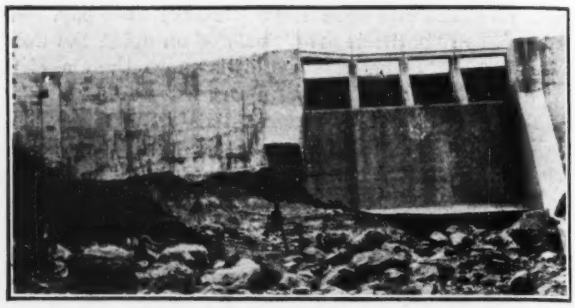
Compulsory ventilation for school buildings is being urged in Missouri and Kansas, and a joint committee on the subject has been appointed by the Kansas City chapters of the American Institute of Architects and the American Society of Heating and Ventilating Engineers. This committee will coöperate with the Kansas State Teachers' Association and the Kansas State Association of Public Health Officers, both of which organizations are interested in the matter.

Home-Made Concrete Dam at Hill, New Hampshire, Fails

Remains of Structure Designed Without Engineering Advice Show Poor Workmanship—Flood Causes Much Damage

FAILURE of a concrete dam about 100 ft. long and 35 ft. high at Hill, N. H., about 25 miles north of Concord, on the evening of May 29, caused considerable property damage and the loss of one life. The destruction extended for a distance of half a mile below the dam. Three highway bridges and a railroad bridge were washed out, two factories and a number of houses were wrecked, and three other dams were more or less damaged. A brief investigation of the disaster made for *Engineering News-Record* by George G. Shedd, Chester W. Smith, and P. A. Shaw of L. H. Shattuck, Inc., engineers and contractors, Manchester, N. H., indicates that the structure, which was built without engineering advice, was deficient in several respects.





HOLE TORN THROUGH DAM, AS SEEN FROM UPSTREAM AND DOWNSTREAM SIDES, RESPECTIVELY
Note in right-hand view end of dam abutting in hardpan bank, and buttress fallen away because of lack of bond

The Woodward dam is situated on Flander's Brook, a tributary of the Pemigewasset River, about half a mile from the village. The total fall from full reservoir to the river is about 120 ft. The drainage area is approximately 8 sq. miles, and the reservoir is estimated to have an area of from 20 to 35 acres, with a maximum depth of 30 ft. The dam was built to supply power for the New England Novelty Co. and the electric light plant furnishing electricity for the village of Hill.

A short distance below the dam is another concrete dam. Just below that were the electric light plant and the novelty works in the same building. A highway reaching this plant crossed the brook at two points and joined a state highway in the village just south of its crossing over the brook. East of the state highway the Bristol branch of the Boston & Maine R. R. crossed the brook. Along the brook were also a timber crib dam, a timber frame dam and the plant of the George H. Adams Needle Company.

Following are comments on the disaster by Mr. Shedd:

"The failure of the Woodward dam illustrates to a marked degree the necessity of competent engineering advice in the design and supervision of construction of dams. The owner, a successful manufacturer, designed and supervised this dam with the help of a good mason for his foreman.

"The dam, which was completed about four or five years ago, is of cyclopean concrete, about 35 ft. high above the bed of the stream and about 100 ft. long on its crest, with a wing wall extending some 75 ft. further on the left bank. The banks are steep and generally are of a hard cemented sand and clayey material, with occasionally a layer of pure sand.

"The sketch shows the general design of the dam. No plans are available and the depth to which the foundations were carried could not be determined definitely upon our brief visit. The owner states, however, 'that they were in general carried 10 or 12 ft. below the original surface, and that the bottom was of hard material and was tested every 2 ft. longitudinally by driving an iron bar down from 12 to 18 in. In some cases the bar had to be pulled by a derrick.'

"The spillway is 34 ft. long with three piers supporting flashboards. The thickness of the spillway wall is about 11 ft. where it rests upon a foundation some 5 ft. above the bed of the stream. The foundation below this point is apparently carried down vertically about 15 ft. wide. At each end of the spillway was a buttress. The right abutment, which was the one that failed, was 4.2 ft. wide on top for the greater part of its length, but increased to 9.5 ft. at the spillway. It was built plumb on the upstream side, with a very slight batter on the downstream side. A narrow buttress supported the abutment about midway of the thin portion of the abutment. The 30-in. penstock was built into the dam just to the right of the spillway. At the upstream end of this was a gate and screen chamber. Below the spillway in the bed of the stream there was a thin concrete apron extending possibly 10 ft. downstream.

"The dam failed about 7.30 p.m., May 29. A watchman employed by the novelty works first noticed an unusual amount of water coming over the old concrete dam just above the novelty works, and thinking some boys had opened the upper dam gate, started up to investigate it. He found the water coming through in great quantities immediately under the gate. He rushed back to telephone, and warned the owner and the people below. The owner had time to drive nearly up to the dam before it finally broke away.

"In its path down the stream the flood first destroyed both wings of the concrete dam immediately above the novelty works, demolished the greater portion of the factory, took out completely a new two-story house just below, completely obliterated a highway bridge and then was somewhat retarded by filling in a flat above the

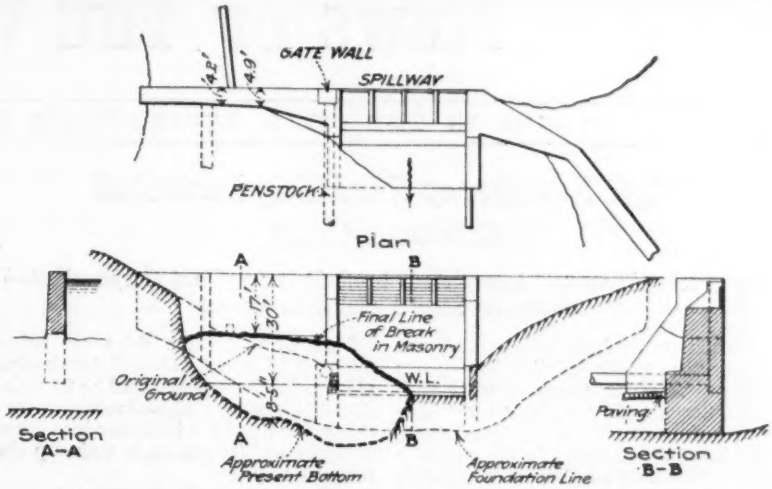
next highway bridge. This second highway bridge had an opening between abutments of about 10 x 30 ft., and the flood marks show that the water stood about 6 ft. above the bridge. The flood area at this point is about 850 square feet.

"Several hundred feet below this bridge was a stone-filled timber crib dam. The flood overtopped this dam about 8 ft. without doing serious damage, except that it washed around the right end, making a hole about 60 ft. wide, and displaced the penstock from this dam to the needle works. The next dam below is a simple frame timber dam which also stood the flood without damage to itself, although the water cut into the right bank 10 or 15 ft. Immediately below this last dam is the George H. Adams Needle Co. A wing of this factory was completely torn off, and considerable damage was done to the equipment.

"Below the needle factory a large dwelling was removed from its foundations and a tenement in an ell completely torn off and demolished. The bridge at the state highway was completely washed out, as well as a number of buildings in this vicinity. The bridge of the Boston & Maine R. R. was washed out, as well as several hundred feet of the embankment.

"Throughout the path of the flood the banks were badly eroded, and trees were uprooted. Eyewitnesses state that the bulk of the flood passed in about twenty minutes and that in forty-five minutes from the time the first warning was given the stream was practically back to normal again.

"The sketch and photographs show the break in the dam. Opinions differ as to whether the first break occurred in the masonry itself, or whether the foundation under the masonry was first washed out. Soundings and a detailed examination of the bottom have not yet been made, so it is impossible to make a definite statement as to just what did occur.



SKETCH PLAN, ELEVATION AND SECTIONS OF FAILED DAM AND OUTLINE OF BREAK

"The masonry, however, shows very poor workmanship. No attention was apparently shown to bond. The fracture shows several large flat stones bedded in the same plane, and also numerous large voids, indicating that the stones were placed first and the concrete was dumped around them, a procedure that is not allowed in good practice.

"The dam section is extremely light; in fact, it is difficult to understand why the dam did not break when it was first filled. As it has stood so long, however, it seems reasonable that the failure did not originate in the masonry, but did originate in a small leak under the foundation which gradually grew larger and finally washed out enough supporting earth to allow the masonry to give way at a point where the bond was weak."

These are the conclusions drawn by Mr. Shedd and his associates:

1. The foundation was not suitable for a dam of this type and height.
2. Even with a good rock foundation the dam was much too light to be considered safe.
3. The materials were fairly good, but the workmanship was poor.

The dam was built previous to the passing of the New Hampshire law which provides that plans for all new dams shall be submitted to the Public Service Commission for approval.

CHARACTER OF MASONRY SEEN AT CLOSE RANGE

Alaskan Railway's First Shipment of Coal

The first commercial shipment of coal over the new Alaskan Government railway from the mine operated by the Alaskan Engineering Commission was made in the last week of April. A consignment of 100 tons from the Chickaloon field went to Seattle, Wash., on the steamship Alameda. The coal was shipped in sacks under a freight rate of $5 per ton for shipments of 100 tons or more, and $7.50 per ton on shipments of less than 100 tons.

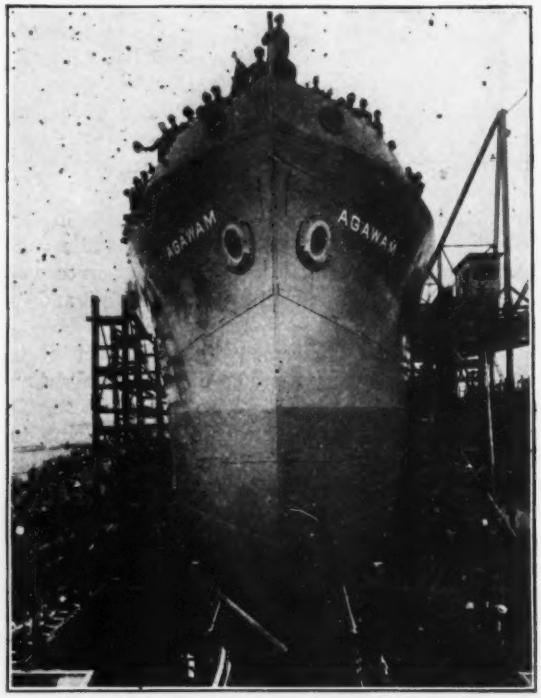
NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

First Emergency Yard Ship Launched at Newark Bay

Freighter "Agawam" Completed by Submarine Boat Corporation—5500-Ton Steel Fabricated Vessel

Turning out fabricated steel ships at the agency yards of the Emergency Fleet Corporation began May 30 with the launching of the freighter "Agawam" at Newark Bay by the Submarine Boat Corporation, in the presence of Director General Charles M. Schwab, representing the Fleet Corporation. The "Agawam" is one of a lot of 150 vessels of identical size and construction which the Newark Bay yard is building for the Government. It is 343 ft. long on deck, 46 ft. in beam, and 28½ ft. deep (molded). At 23 ft. draft the vessel has a carrying capacity of 5500 gross tons, and is expected to maintain a speed of 10½ knots.



TWO VIEWS OF "AGAWAM"—JUST BEFORE AND JUST AFTER LAUNCHING

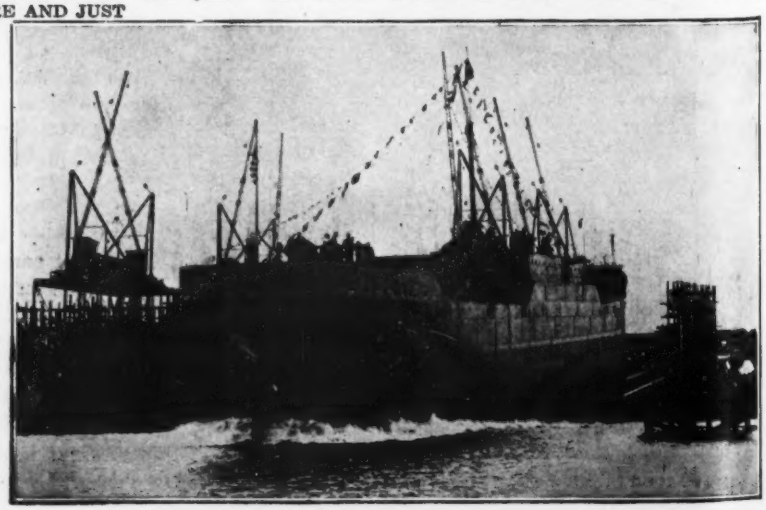
The Newark Bay yard was built last fall and winter, the Emergency Fleet Corporation having contracted for the ships in September. Twenty-eight shipways were laid out, and ship steel is now being erected on all of them. Machinery and equipment will be installed at a fitting-out dock along one side of the yard.

Hull parts for the ships are being made at 56 structural-steel fabricating plants, steel being furnished by 27 mills. About 200 other shops—foundries, machine shops and the like—produce other material and equipment to make up the finished ship.

The parts are fabricated in the outside shops as completely as practicable, and shipped to the yard ready for erection. The curved plates and frames of the hull are shaped in the shipyard shops, but the straight parts arrive at the yard punched and riveted complete. The transverse frame members in the double bottom are assembled in groups of two or three with the connecting intercostals, before shipment, to save some of the field riveting and speed the erection. Henry R. Carse, president of the Submarine Boat Corporation, said in an address at the launching that 95% of the work in forming the parts of the hull is done at distant shops, from drawings and templets furnished by the yard. He stated that the parts when brought together at the yard fitted perfectly.

The keel of the "Agawam" was laid in December, when the yard was still under construction. The schedule for the construction of the remaining 149 ships calls for launching and delivery of two or three vessels every week.

[A description of the erection equipment at the Newark Bay yard will be found on p. 1073 of this issue of *Engineering News-Record.*]



War Industries Board Now Independent Body

Overman Law Gives President Power to Confer Rank Equal to That of Other Departments

The War Industries Board has been made an independent department of the Government with executive powers, through an order issued by President Wilson. Originally the industries board was a division of the Council of National Defense. Under the terms of the Presidential order, the War Industries Board now becomes as much an executive department of the Government as is the Treasury Department or the War Department. The creation of the board as a distinct branch of the Government, responsible directly to the President, was made possible by the terms of the Overman law authorizing the President to reorganize Governmental departments and agencies.

The advisory commission of the Council of National Defense, under which the War Industries Board was previously constituted, was intended to act purely as an advisory body, whereas the work of the Industries Board was executive, i. e., the War Industries Board was an executive

body subordinate to an advisory body of the Government. This situation was responsible for the radical change in organization which has now been made.

Two Big Federal Managerships Go to Engineers

Elisha Lee and A. W. Thompson have been appointed Federal managers of the Eastern lines of the Pennsylvania and Baltimore & Ohio R.R's, respectively. Samuel Rea and Daniel Willard will remain presidents of the companies, in charge of corporate affairs.

Both Mr. Lee and Mr. Thompson are engineers. Mr. Lee has been in the service of the Pennsylvania since his graduation from the Massachusetts Institute of Technology in 1892. In 1909, when he had advanced in the maintenance-of-way department to principal assistant engineer, he was made superintendent of the New York, Philadelphia & Norfolk R.R. He was subsequently promoted to be assistant to the general manager, general superintendent, assistant general manager, general manager and vice president. His promotion to general manager occurred early last year. Mr. Lee has had a prominent part in the negotiations between the railroads, the brotherhoods of trainmen and the arbitration boards regarding the various wage controversies of recent years.

Mr. Thompson, likewise, has been with the Baltimore & Ohio since his graduation, in 1897, from Allegheny College. He was successively assistant engineer, division engineer, division superintendent, chief engineer maintenance of way, chief engineer, general manager and vice president. Last November he was chosen by the Railroads' War Board to establish headquarters at Pittsburgh and attempt to relieve the congestion there.

George W. Stevens, formerly president of the Chesapeake & Ohio Ry., has been made Federal manager of that road.

New Highway Will Have Tunnel One Mile Long

A tunnel a mile long will be a novel feature on the highway to be built between Clark's Summit and New Milford, Pa. The road will be built upon right of way released by the Delaware, Lackawanna and Western Railroad Company.

The land was vacated some years ago by the railroad, but up to the present time legal difficulties, such as the release of reversionary rights by abutting property owners, have stood in the way of the work.

These have now been overcome by the efforts of the Lackawanna Trail Assn., and the state has accepted the old roadbed for a state highway.

The road will supply a much needed route between Scranton, Pa. and Binghamton, N. Y.

Government Has Openings for Technical Men

The United States Civil Service Commission is experiencing difficulty in obtaining a sufficient number of eligibles for many lines of work, and it urges qualified persons to offer their services to the Government at this time of great need. Among the positions now open are the following:

	Usual Entrance Salary
Supervising engineer, construction	$9.04 to $16.00 a day
Assistant material engineer	4.48 to 6.40 a day
Refrigerating engineer	3,000 a year
Construction engineer	2,400 a year
Planning expert	2,400 a year
Architect	2,500 to 3,500 a year
Structural designer	2,400 to 2,700 a year
Architectural designer	2,100 to 2,700 a year
Senior architectural draftsman	1,800 to 2,100 a year
Junior architectural draftsman	1,200 to 1,800 a year
Architectural tracer	1,000 to 1,200 a year
Engineering draftsman	3.04 to 7.04 a day
Mechanical draftsman	4.00 to 8.00 a day
Metal furniture draftsman	4.00 to 6.00 a day
Apprentice draftsman	480 a year
Ship draftsman	4.00 to 6.88 a day
Copyist draftsman	2.00 to 3.44 a day
Topographic and subsurface draftsman	4.48 to 5.04 a day
Expert in motor-vehicle standardization	1,600 to 3,000 a year
Assistant inspector of hull material	4.48 to 5.04 a day
Subinspector, mechanical	3.52 to 6.00 a day
Assistant inspector of engineering material	4.00 to 4.48 a day

Applicants are not required to report at any place for examination but are rated upon their education, training and experience, and in some cases on work submitted with the application. Physical ability is also considered in some instances. Ratings are arrived at from information set out in the application blank and from corroborative evidence.

The commission calls particular attention to the fact that all necessary information concerning civil service positions, and application blanks therefor, may be obtained free by applying to the commission's representative at the postoffice in any important city, or by addressing "The United States Civil Service Commission, Washington, D. C." Many of the drafting positions are open to women.

Concrete Steamship Makes Trip in Rough Weather

The concrete steamship "Faith," recently completed at San Francisco, made the trip from San Francisco to Seattle in six days and four hours, under adverse weather conditions. Though the time was slow, it is considered by marine men as fast as the average vessel equally powered would have made under similar weather conditions. The boat is reported to have encountered gale after gale with a velocity of 75 to 80 miles per hour. During the worst of the blows the vessel was slowed down to 2 to 4 knots, using only such power as was required to hold up against the head wind. C. C. Kinsman, the chief engineer, reports that not more than 1500 hp. of the 1750 hp. available was used at any time.

F. R. McMillan and H. S. Laeffler accompanied the "Faith" as representatives of the Emergency Fleet Corporation. They made continuous records of stresses in various parts of the ship by means of a recording strain gage designed specially for this purpose. The adverse weather encountered gave an excellent opportunity to study the behavior of the reinforced-concrete hull in high seas.

In describing the trip it was said that the boat developed but slight roll despite the heavy seas and that there was a notable absence of the vibration usual in steel or wooden vessels when waves broke over the deck. The chief engineer's comment was, "I never slept better on any ship."

Elected as Members of Board, Engineering Foundation

At the regular meeting of the trustees of the United Engineering Society, which was held in New York, May 23, Calvert Townley, of the Westinghouse Electric & Manufacturing Co., New York, was elected a member of the Engineering Foundation Board to succeed Gano Dunn.

The following additional members were elected:

Silas H. Woodard, consulting engineer; Dr. Joseph W. Richards, professor of metallurgy, Lehigh University, South Bethlehem, Pa.; Dr. David S. Jacobus, advisory engineer, Babcock & Wilcox Co., New York; H. Hobart Porter, of Sanderson & Power, consulting engineers, New York.

Highway Traffic Association Will Hold Meeting June 12

A public meeting of the Highway Traffic Assn. of the State of New York will be held in the grill room of the Automobile Club of America, 247 West 54th St., New York City, at 8:30 p.m., June 12.

Gen. Francis V. Greene, George H. Pride, member of the highways transport committee of the Council of National Defense, William A. Bassett, of the Bureau of Municipal Research of New York City, and Joseph K. Orr, president of the New York Team Owners' Assn., will speak on the topic, "Should Unnecessary Obstructions and Pavements Full of Holes on New York City's Main Commercial Traffic Streets Be Tolerated During the War?" The addresses will be followed by a general discussion.

Agitate for Old Design of Ohio River Bridge at McKees Rocks

The War Department authorities at Washington have again been requested to permit the erection of the bridge over the Ohio River at McKees Rocks, on the lines originally drawn by the local authorities. The plans were held up because of the demand of the War Department that the span be made 200 ft. longer than in the original designs.

The local authorities now believe that the War Department may recede from its original position in the mat-

ter on account of the probable value of such a bridge in connection with the new ordnance plant on Neville Island. The local authorities have asked for permission to proceed at once.

Board Finds Canadian Northern Stock Worth $18 a Share

A valuation of $18 per share, making a total of $10,800,000 for the 600,000 shares of common stock of the Canadian Northern Ry. in private hands, was announced May 25 by the board of arbitration sitting in the case. The Dominion Government already owns 400,000 of the million shares of common stock; and last year the Dominion Parliament passed an act for the acquisition of the remaining shares, most of which are held by the Mackenzie-Mann interests. The arbitration board to determine the amount to be paid has been sitting since March.

In reaching its conclusions the board accepted as an index of the surplus of assets over liabilities the valuation of $25,000,000 made by Prof. George F. Swain for reproduction cost less depreciation. The board did not consider this a true indication of the value of the stock, however, on account of the uncertainty of the company's prospective earning power. The board said:

"Prospective earning power is perhaps more important than any other element in ascertaining the value, and in arriving at a conclusion we have given careful consideration to the past history of the company, its earnings and expenditures, the present financial position of the company, the location of its lines and their construction, the other railways already existing in competition, the rate of interest on the funded and other debts of the company, the probable future growth of the population and business of the country, and all other facts which seemed to us to have any bearing upon the question. It is apparent that there is great room for difference of opinion in the matter involving so many elements of uncertainty and speculation, but after taking into consideration all the circumstances which appear to us to be entitled to weight in determining so difficult a question, we came to the conclusion we have mentioned."

The actual payment will be reduced to $16.66 2/3 per share, inasmuch as the Parliamentary act limited the total payment to $10,000,000. Representatives of the company, on the other hand, claimed a value of $50 per share.

Free Anti-Typhoid Inoculation

The United States Public Health Service will administer anti-typhoid inoculation without charge to all who apply to any of its hospitals or field offices, according to an announcement. Information as to the location of hospitals and field offices where this inoculation can be secured may be obtained by addressing the Public Health Service, Washington, D. C.

Conter on Return Load Bureaus and Rural Motor Express

A conference to form a national organization for the promotion of return load bureaus and rural motor express routes was held in Washington June 4-5. The membership of the conference was composed of the highways transport committee of the Council of National Defense and similar committees of State councils of defense. It expected to work out a definite program already formulated by the highways transport committee of the Council of National Defense. A definite program has been prepared for each state that will promote the use of motor trucks in the most efficient manner along these lines.

Bulletin No. 2, entitled "The Rural Motor Express," has just been issued by the highways transport committee of the Council of National Defense. In it the committee emphasizes the need, so often expressed lately, of greater use of our highways for transportation purposes. It explains the purposes for which motor-truck transportation is recommended, gives a plan of organization, cites those Government departments which have advocated its use and their reasons therefor, and gives examples of cases in which it has been used successfully.

Open Trent Canal Connecting Lakes Ontario and Simcoe

The Trent Canal, which has been completed from Lake Ontario to Lake Simcoe, was formally opened for traffic on Monday of this week by the Hon. J. D. Reid, manager of railways and canals of the Dominion of Canada. The occasion was marked by elaborate ceremonies.

Although communication has been established between Lake Ontario and Lake Simcoe by the completion of one section of the canal, work on the Severn River section has been suspended and will not be resumed until after the war, because of the high cost of labor and materials and the demand for money for other more pressing needs. It is expected that the opening of the canal to Lake Ontario will be a strong factor in facilitating shipments of coal to Peterboro and other points on the canal by an all-water route. The Trent Canal has been under construction for more than a quarter of a century and some sixteen and a half million dollars have been expended in its construction. From Lake Ontario to Peterboro, it has a depth of 8 ft. 4 in., and from there on a depth of 6½ feet.

Decision Against Luten Spandrel and Bar Patents Upheld

The United States Circuit Court of Appeals for the sixth circuit, Judges Warrington, Knappen and Denison, on May 7 affirmed the judgment of the lower court in the case of Daniel B. Luten vs. W. F. Whittier et al., involving certain patents on reinforced-concrete arch bridge design. The lower court case was decided Oct. 13, 1916, in the United States District Court for the Southern District of Ohio, when Judge Sater dismissed the bill on the ground that the patents were invalid. The patents involved were No. 853,203 (Claims 3, 7, 10, 15, and 21) and No. 1,070,903 (Claim 1). The former patent is on a method of placing reinforcement in an arched concrete bridge so as to unite the spandrel to the barrel and thus strengthen the latter. The latter patent is on reinforcing bars in which transverse ribs are spaced apart more than ten times their height.

To Return Highly Skilled Drafted Men to War Industries

In response to appeals from all over the country, the War Department has decided upon a policy which will permit the return to necessary industries of highly skilled men taken from such industries, under a system of furlough which will be automatic, and which will not in the future, as in the past, leave to the discretion of company and other subordinate commanders the question of whether such furloughs shall be granted. Thousands of applications for such furloughs are now being sent out of Washington by various branches of the War Department, in response to the appeals of manufacturers and other producers of war material whose draftsmen, mechanics and other employees, engaged upon Government orders for war work, have been taken from them by operation of the draft.

The adoption of the new policy means that enlisted men are to be returned to industry only in cases where the drafted man's employer is willing to swear that the man is badly needed and that no one can take his place. Detailed information is contained in an application blank which the Government will supply.

While such men are on furlough they are not to be allowed to wear the uniform. The companies employing them must furnish to the Government each month a report that they are still in employment and the class of work engaged in. In case such men leave their employment, the employers must immediately notify the Government.

Thousands of applications for furloughs for enlisted men in necessary industries have recently reached Washington, and the War Department has been unable to grant permission for the necessary furloughs because company commanders and others held that certain of their men might be more necessary in the ranks than in civil life. The Adjutant General's office has now sent a circular to heads of War Department divisions permitting the operation of the new system. The Government is protected, by the fact that whenever a fraud is perpetrated, or attempt is made to perpetrate fraud, sufficient persons will be familiar with the circumstances to result in the department being notified.

Government Contracts for Two Large Acid Plants

Contracts have been awarded by the Ordnance Department for the establishment of two large picric acid plants at Little Rock, Ark., and Brunswick, Ga. The Little Rock plant was let to the E. M. Davis Chemical Corporation, and the Brunswick plant to the Butterworth-Judson Co., New York. The former will cost approximately $4,000,000 and the latter $7,000,000.

War Housing Discussed at City Planning Conference

War housing was one of the principal topics of discussion at the Tenth National Conference on City Planning, held in St. Louis, May 27-29. Frederick Law Olmsted, president of the conference and a member of the housing committee of the Council of National Defense, reviewed the steps taken by the Government in war housing from the time cantonments for the National Army were first decided upon, up to and including the present activities of the Shipping Board, the Ordnance Department and the Department of Labor. Lawson Purdy, New York City, presented a plan for financing the homes of war workers. Thomas Adams, town planning adviser of the Conservation Commission of Canada, told of the housing of war workers in the European allied countries. Plans of several successful low-cost housing schemes for war workers were shown.

One session was devoted to the discussion of the St. Louis plan, particularly the major street plan and the recently prepared zoning plan. E. P. Goodrich gave a digest of the industrial survey being prepared for the Chamber of Commerce, which brought out the fact that St. Louis is short of skilled labor and that St. Louis should assume the lead in the development of Mississippi River traffic. Other sessions were devoted to zoning, blighted districts, waterways and the planning and construction of the cantonments.

The conference adopted a resolution calling on cities not to postpone the planning of public work which must be done once war conditions will permit. The conference also adopted a resolution favoring the development of separate and distinct housing schemes for industrial workers in plants engaged in war work instead of scattered miscellaneous developments of houses singly or in groups, to the end that there may be more economy and less exploitation.

Frederick Law Olmsted, Cambridge, Mass., was reëlected president of the American City Planning Institute, under whose auspices the yearly conference is now held. Other officers reëlected were Nelson P. Lewis, New York City, vice-president, and Flavel Shurtleff, Boston, secretary.

No Manager for Poughkeepsie

Adoption of the commission-manager plan of city government was defeated by the electors of Poughkeepsie, N. Y., May 28, by a vote of 1635 ayes and 1805 noes, or an adverse majority of 170.

Builders and Architects to Hold Conference

Special Meeting in New York June 14 to Discuss the Best Ways to Cooperate with Government

A special joint conference of architects, building material societies, building employers' associations and organizations of building and allied interests has been called to meet in New York City, June 14, at the Engineering Societies Building, 29 West 39th St., in an effort to find a basis upon which the construction and building material interests of the country can lend complete coördinated assistance to the Government in the adjustment of building to the war winning program.

The convention has been called to meet under the auspices of the American Institute of Architects. The program has been arranged to permit the working out of the most practical plans.

It is reported that the conference is the result of a request from the War Industries Board to the United States Chamber of Commerce to assist in bringing together all trades, professions and industries not already coördinated, so that should necessity arise the Government can operate them as units. It appears to have been generally realized that a serious situation might develop unless much closer working relations should be effected between the nation's building activities and the Federal authorities, partially due to the construction program that is developing at Washington and the increasing need for meeting the demand for housing of labor engaged in war industries.

Large Hydraulic Turbine for Niagara Plant

What is said to be the largest hydraulic turbine so far built, or under construction, is to be installed by the Hydraulic Power Co., Niagara Falls. The normal operating conditions for which the turbine has been designed are as follows: Heads from 213 to 214 ft.; speed, 150 r.p.m.; discharge, 1500 cu.ft. per second; capacity, 37,500 hp. It will be installed in the extension of the above-named company's Station No. 3.

The contract for the turbine has been placed with the I. P. Morris Department of William Cramp & Sons Ship and Engine Building Co., Philadelphia.

Central Station Hot Water Heating Conference

Proposed rules and contract forms to govern service from central hot water heating plants were the subject of a conference June 4, in the rooms of the Public Service Commission of Indiana, State House, Indianapolis. The rules, which are tentative only, have been drafted by the engineering department of the commission, in collaboration with the United States Bureau of Standards. H. O. Garmon is chief engineer of the commission.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS; 129 York St., Brooklyn, N. Y.; June 19-22, Berlin, N. H.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; University of Pittsburgh; June 26-29, Northwestern University, Evanston, Ill.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston; June 27-29, Atlantic City, N. J.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 25-28, Atlantic City, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS; 29 West 39th St., New York; June 26-28, Atlantic City, N. J.

The American Concrete Institute has announced the provisional program for the convention to be held at the Hotel Traymore, Atlantic City, June 27-29. The convention will have seven sessions, the first of which, on Thursday night, June 27, will be a joint session with the American Society for Testing Materials, at which subjects of interest to both societies will be discussed. Special prominence is to be given at the Concrete Institute's meeting to the design and construction of concrete houses and concrete ships, a full session being devoted to each of these two subjects.

The bill amending the charter of **the Canadian Society of Civil Engineers** having been adopted, the organization will henceforth be known as **the Engineering Institute of Canada.** Its scope will be extended to include the entire engineering profession in Canada, with headquarters at Montreal and branches in other cities, with mechanical, electrical, civil, mining and chemical divisions.

The Russian Society of Engineers of Chicago will be addressed June 8, at the Sherman Hotel, by U. M. Lomonosoff, professor of railroad engineering, University of Moscow, on "The Present Industrial Conditions in Russia and What Can Be Done to Improve Them." Professor Lomonosoff was assistant to the Russian ambassador to the United States from the first revolutionary government. M. Grodsky, with the Tait Engineering Co., was recently elected secretary of the society.

The Civil Engineers' Club of Sioux City, Iowa, was addressed at its meeting on May 24, by J. E. Freeman, member of the National Committee of Concrete Shipbuilding, on the history and construction of concrete ships.

The Engineers' Club of Dayton was addressed May 28 by E. S. Votey, vice-

president, the Aeolian Co., New York, who described in detail the workings of the player piano manufactured by his company, illustrating his remarks by exhibiting the various parts of the instrument. The object of his talk was to call especial attention to the pneumatic features and more especially to their remarkable sensitiveness to changes in air pressure.

The Nebraska Association of Members of the American Society of Civil Engineers held its 14th regular meeting on June 1, which was, in part, devoted to a discussion of the proposed constitutional convention for the State of Nebraska.

PERSONAL NOTES

GEORGE D. EARL, general superintendent of the Sewerage and Water Board, New Orleans, received the degree of doctor of science from Lafayette College on May 31.

ROBERT FLETCHER, director of the Thayer School, Dartmouth College, received the degree of doctor of science at the commencement exercises of the college, held May 27.

W. C. A. PALMER, supervising engineer, Bureau of Public Works, in charge of Western Visayas, P. I., has resigned to become division superintendent of the Philippine Railway Co., with headquarters at Cebu.

E. F. KETTER has become chief draftsman for the United States Coal and Coke Co., with headquarters at Gary, W. Va.

LLEWELLYN N. EDWARDS, formerly structural engineer, Grand Trunk Railway System, and more recently supervising engineer of bridges, with headquarters at Toronto, is now stationed at Camp Lee, Petersburg, Va., with the rank of captain, United States Engineers.

COL. HENRY W. THORNTON, who was called from the Long Island R.R. four years ago to accept the general managership of the Great Eastern Ry. of England, has been made a brigadier general of the British Army. General Thornton is an American engineer, a product of the Pennsylvania system. Beginning work on the lines west in 1894, after graduation from the University of Pennsylvania, he advanced to the post of engineer maintenance of way in 1899, was made division superintendent two years later, was transferred to the Long Island R.R. in 1911 as assistant general superintendent, and was promoted the same year to be general superintendent. He remained general superintendent until February, 1914, when he was invited to introduce American railroading methods on the Great Eastern Ry. He was commissioned as a colonel shortly after the beginning of the war. His recent advancement is understood to have been in recognition of his efficient work as director of the Channel transports.

JOHN M. HARTGERING, formerly with C. W. Hubbell, consulting engineer, Detroit, has become sanitary engineer for the Board of Health, Detroit, succeeding Donald M. Bingham, who resigned to enter the service of the Emergency Fleet Corporation at the Pacific Coast shipyards.

SAMUEL L. TOLMAN has resigned as superintendent of the city garbage and sewage disposal plants, Mason City, Iowa, to enter the sanitary corps, National Army, with the commission of second lieutenant.

WARREN STOUTNOUR of the Public Utilities Commission of Utah has been commissioned a lieutenant in the United States Naval Reserve. Mr. Stoutnour was released from his duties as a member of the Commission on May 27, when he proceeded to an Atlantic port to report for duty.

A. C. EVERHAM, until recently terminal engineer of the Union Pacific R.R. at Kansas City, Mo., is now supervising constructing quartermaster in the construction division of the National Army at Washington, D. C., with the rank of major.

L. G. CURTIS, district engineer of the Baltimore & Ohio R.R. at Chicago, has been appointed assistant chief engineer, with headquarters at Baltimore, Md.

FLOYD F. HANLY, division engineer, Baltimore & Ohio R.R., with headquarters at Cumberland, Md., has received a commission as first lieutenant in the United States Corps of Engineers. W. T. Hughes, previously assistant division engineer, will succeed Lieutenant Hanly. For the past two years Mr. Hughes has been in the office of the district engineer at Baltimore.

VICTOR GALINEAU, engineer for the State Board of Commerce and Navigation of New Jersey, has become acting director of the board. Mr. Galineau has been in the service of the board for the past six years, and was formerly connected with the Department of Inland Waterways. Since the resignation of John C. Payne the board has been without a director, and the work has been done by Benjamin F. Cresson, consulting engineer of the board.

HARRY F. SCHAEFER has been appointed engineer in charge of sewer work, Baltimore, filling the vacancy created by the resignation of Thomas D. Pitts, who is now with the United States Shipping Board.

CURTIS C. MYERS, professor of industrial engineering, University of Cincinnati, has been commissioned captain in the Ordnance Department, Washington, D. C.

JULIUS ALSBERG announces the opening of consulting offices in the Tribune Building, Chicago. He proposes to investigate and report on mechanical, industrial and chemical engineering problems, to design plants and to supervise their installation.

PHILIP H. BEAUVAIS has been appointed city manager of Manistee, Mich. In addition to the work of city manager Mr. Beauvais' duties will include those of city engineer and superintendent of the water-works.

H. E. CARLIN, formerly chief engineer, Kentucky River Power Co., Hazard, Ky., has been named as general manager of the Hazard Electrical Supply Co., which was recently organized at Hazard.

ALFRED M. LUNN, of Lund & Hill, consulting engineers, Little Rock, Ark., is now stationed at Camp Humphreys, Va., as sanitary inspector, with the rank of major in the sanitary corps, National Army.

JULIAN MONTGOMERY, chief office engineer of the State Highway Department of Texas, has received a leave of absence to enroll in the fourth officers' training camp at Camp McArthur, Waco, Texas.

OBITUARY

JOHN HENRY MACMICHAEL, inventor of the pneumatic concrete mixing and conveying system, died in Chicago May 25. He was born in Blenheim, Ontario, Can., 57 years ago. In 1905 Mr. MacMichael entered the contracting business and two years later, on the Howard-Dennison reinforced concrete viaduct, Cleveland, tried out the pneumatic process for the first time on a large contract. Many experiments were carried out in Chicago at the shops of the Standard Machine & Tool Co., before the first big undertaking, in 1911, that of lining the La Salle Street tunnel tubes in Chicago. Since then many notable tunnels have been lined with the process and much outside work has been done. Mr. MacMichael was assisted in developing his latest ideas on the substitution of steam for air by his son, J. H. MacMichael, Jr., who left Armour Institute nine months ago to become a lieutenant in the aviation corps. He is now detailed to Selfridge Field, Mount Clemens, Mich., as an instructor.

JOHN A. CONNOLLY, marine engineer and pioneer shipbuilder, died at his home in Brooklyn, N. Y., June 2. Mr. Connolly was in his 88th year and had been engaged in the shipbuilding industry nearly all his life. He was the designer of many noted vessels of the last generation, among them the United States gunboats "Seneca" and "Chenango" in the Civil War and the steamboats "Grand Republic," "General Slocum" and "Columbia."

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Entire Steel Output for Government Needs

One Hundred Per Cent Capacity Pledged But Producers Believe There Will Be Surplus Supply

Every ton of steel produced in the country was pledged to the United States Government at a recent meeting of the steel producers and J. L. Replogle, United States steel director. The pledge included a promise of a 100% capacity output which is now rapidly being reached. Producers believe that, although all private contracts are pigeon-holed for the present, this quantity will not be required for more than a short time.

At present, war requirements are absorbing nearly all the tonnage and it is being strictly regulated by the priorities committee of the War Industries Board. The requirements of the United States and our allies will approximate 20,000,000 tons; for projectiles 5,000,000 tons will be needed; for plates 2,500,000 to 3,000,000 tons; for railway replacements, 2,000,000 tons; for car orders, 1,300,000 tons.

One of the indications that the 100 per cent. capacity output is being reached lies in the fact that the Carnegie Steel Co. alone has 54 of its 59 stacks in the Pittsburgh district running, and the mills have already reached 93 per cent of the ingot rating. In 1912 the steel output broke all records; yet the production capacity was not large in relation to the requirements of the country, and in 1916, when the total steel production amounted to more than 42,500,000 tons, but 333 of the 448 stacks were in operation, or less than 80%. The theoretical capacity of the industry in August, 1917, was 50,000,000 tons, exclusive of castings; the production of ingot in 1916 was more than 41,000,000 tons and by August, 1917, had been exceeded by more than 6,000,000 tons, or an increase of 15%. On the other hand, every effort is being made to utilize all of the scrap steel available, as is indicated by the fact that a method is being used to utilize the shell discard, a material which had heretofore been considered too hard to be reconverted.

Reports of the United States railroad administration show marked improvements in the freight movement of April of this year. If the coal shipments from the mines are maintained at the present rate the supply will meet the demand indicated by the United States fuel administrator. These factors are contributing to the rate of production which, if maintained, will cause the industry to pass the 50,000,000-ton mark in 1918.

Further illustration may be had from the accounts of the rolled steel industry as given in the report of the Iron and Steel Institute. More than 30,500,000 tons were rolled in 1916, 20% of which, or 6,500,000 tons, went for export. Assuming that the 15% increase which was made in 1917 is maintained, there will be a production for this year of 35,000,000 tons. Deducting from this the 6,500,000 tons for export leaves more than 28,000,000 tons, of which Government requirements for direct war needs will not exceed 4,000,000 tons. This leaves 24,000,000 tons for the indirect war needs and outside consumption.

Steel shipments for the past few months to the Government have been extremely heavy so that producers believe the present intensive shipping will ease up after the next two months and the joint committee representing the Government and the steel manufacturers, which was appointed May 17, will shortly commence work to determine the relation between the supply and the war demands month by month, and what surplus there will be. This surplus will be distributed to the industries, going first to those indirectly contributing to war operations and then to the general trade.

Branch Offices Established by Federal Trade Commission

The Federal Trade Commission has ordered the establishment of three branch offices, in New York, Chicago and San Francisco. The following members of the staff of the commission are to be in charge of the newly established offices: A. P. Thom, Jr., in New York; Walter B. Wooden, in Chicago, and D. N. Dougherty, in San Francisco.

The New York office is to be in the Custom House; the San Francisco office in the Appraisers' Stores Building, and the Chicago office, for the present, in the Lytton Building, 14 East Jackson Boulevard.

Finance Board Issues Statement to Curb Applications

The number of applications to the War Finance Board for direct loans have been so numerous that the directors have found it necessary to combat an erroneous impression as to the functions of the War Finance Corporation. In order to stop the flood of applications for direct loans which have been received, the directors have issued an additional statement to the effect that the resources of the War Finance Corporation are not intended to be loaned directly to war industries but only indirectly through the banks.

Outlines Method for Obtaining Steel Priorities

War Industries Board Gives Exact Procedure for Placing Orders and Securing Delivery

The exact procedure to be followed in purchasing steel and other materials subject to priority control has been announced by the War Industries Board. The announcement contains complete details for the filing of applications for priority and for the placing of orders. The applicant for priority must first determine whether the steel company will accept the order if priority be granted, since the priority certificate is not designed to compel the acceptance of an order.

When a concern desires steel and cannot place its orders without first receiving a priority certificate, one may be granted on proper showing. In other words, a concern desiring steel should go to its regular source of supply and place its order subject to the obtaining of a priority order from the priority committee of the War Industries Board. If the steel company signifies its willingness to accept the order after priority has been granted, an application covering the tentative order may be made and will be considered by the priority committee. If an order has actually been accepted, priority may be granted thereon, the rating in each case being entirely dependent on the actual need of the steel covered for war or other work of exceptional importance.

In the granting of priorities for steel products, it is further pointed out that no priority will be granted for the replacement or maintenance of stock except in very exceptional cases. However, where it is proved that an urgent need exists for the maintenance of this particular stock for war or other work of exceptional importance, priority will, in some cases, be granted. An affidavit and personal guarantee that the material will be used solely for such purposes must be included in the application, accompanied by a precise statement in detail of the uses for which the materials are required. The application must cover specific orders, as a blanket certificate will not be issued. Applications for priority should be made on Form P. C. 11.

At the time when the detailed directions for obtaining priority orders were issued, the War Industries Board also announced a preliminary general classification of industries demanding preferential treatment, as follows: Ships, aircraft, munitions, military and naval supplies and operations, fuel, food and collateral industries, clothing, railroad

and public utilities. It is pointed out that the several Government agencies as well as the industries and all others affected can apply this general classification of purposes, to which must be accorded preferential treatment, to the industries and plants with which they may be concerned. However, the priorities board will issue "preference lists" from time to time not only of classes of industries but also of individual plants whose operations are of exceptional importance in the conduct of war work.

It is announced that the present general classification should prove of particular interest to non-war industries in planning their activities during the remainder of this year, "when the basic materials entering into the manufacture of many products will be largely, if not entirely, absorbed in direct and indirect war work, and transportation both by rail and water will be acutely congested in several sections, resulting in the curtailment of production and distribution of such basic materials." Non-war industries are urged to plan accordingly, curtailing operations not falling within the general classification of purposes demanding preferential treatment, at the same time, where practicable, converting existing facilities and utilizing existing organizations for war production. This handling is calculated to reduce to a minimum the damage to industry and at the same time to relieve some of the war industries that are now greatly overburdened.

While the War Industries Board has not undertaken to classify any legitimate industry as "nonessential," but only through the use of priority to insure supplying to direct and indirect war industries as nearly as possible 100% of their requirements, it seems reasonably certain that this handling will practically exhaust or very substantially reduce the available supply of some products, resulting in acute shortage of certain raw materials and products.

War Board Appoints Directors for Industrial Zones

Following the division of the country into twenty "industrial zones," the War Industries Board has announced the appointment of zone directors, who will have general supervision of the production of war materials and the curtailment of "less essential" industries in their respective jurisdictions.

The directors are George E. Crawford, Bridgeport, Conn.; William F. Morgan, New York City; Ernest R. Trigg, Philadelphia; George S. Oliver, Pittsburgh; Harper Sibley, Rochester; Myron T. Herrick, Cleveland; Allen A. Templeton, Detroit; Lucius Teter, Chicago; A. Clifford Shinkle, Cincinnati; Frank N. Hoen, Baltimore; W. H. White, Jr., Atlanta; M. W. Bush, Birmingham; Frank D. Crabbs, Kansas City; Jackson Johnson, St. Louis; August H. Vogel, Milwaukee; Louis Lipsitz, Dallas; Frederick J. Koster, San Francisco; A. J. Rhodes, Seattle; Henry I. Harriman, Boston, and D. R. Cotton, St. Paul.

It is the purpose of the board to have manufacturing plants in each zone use as nearly as possible raw and partly manufactured materials which are produced in their own zone.

Prices Expected to Depend Largely on Action of War Industries Board

Markets for Construction Material Stationary at Present, but Overshadowed by Extraordinary Powers of New Executive Branch

There will undoubtedly be a pause in the operations of producers and contractors until the trend of the unusual powers of the War Industries Board in its new status is more definitely indicated. The control of credit—a very necessary step, as pointed out previously—has been accomplished by the War Finance Corporation. Confidence in its powers has already become apparent, but its creation is too recent to cause any noticeable effect on prices.

A sharp rise in new building construction has occurred, but owing to the low level reached last winter, the increase will have to continue at this rate for some time to reach the normal level of previous years. Labor shortage and unrest are such as to make complete recovery hardly possible, although this may be offset by a lowering in the cost of building material through Governmental price fixing. The large Government program for building construction in solving its housing problems has not progressed sufficiently to affect the building situation.

No change in the figures established by Government price fixing has occurred, except in steel. Certain revisions upward have been recommended by the American Iron and Steel Institute covering pig and other iron, including steel forgings, ingots, squares and small shapes, plates, boiler tubes, sheets and tin plates, cold and hot rolled strip steel, chain, bolts, nuts and rivets, cast-iron water pipes, steel and alloy castings. This action, however, is too recent to affect the price list for this month.

The President has approved the zinc price schedule established by agreement between the War Industries Board and zinc producers, fixing Grade A at 12c. per pound, plates and sheets at 14c to 15c. per pound. No change in the price of copper from the present rate of 23½c. per pound has occurred.

Generally, the price situation, outside of prices fixed by the Government, is stationary except in certain paving and building materials. Fluctuations in lumber prices have been due to an increased volume of business resulting from orders placed to anticipate the car shortage that will come from the shipment of crops.

It is expected that the advance in freight rates ordered by the Director General of Railroads, which will go into effect June 25, will be reflected in a slight movement upward throughout the entire price list.

Business Notes

The M. W. Kellogg Co., manufacturers of lap-welded pipe, has transferred its Pacific Coast agency to the Pelton Water Wheel Co., 19th and Harrison Sts., San Francisco.

A. P. McCallie, formerly assistant general sales manager of the Kelley Island Lime & Transport Co., Cleveland, Ohio, has entered military service. A. J. Earl, traffic manager, succeeds Mr. McCallie as assistant general sales manager, and J. F. Potts, of the same company, succeeds Mr. Earl as traffic manager.

The offices of the British-America Nickel Corporation, Ltd., formerly of Toronto, Canada, were removed to the Citizen Building, Sparks St., Ottawa, on June 1.

The Hofmann-Sproul Co. has been organized in Philadelphia to handle iron and steel specialties and scrap material. The officers of the new company are: A. J. Hofmann, president; W. A. Faison, vice-president; T. J. Sproul, treasurer; James McShane, secretary.

The Holtzer-Cabot Electric Co. has announced the opening of a New York office at 101 Park Ave., New York City.

Trade Publications

The Modern Iron Works, Quincy, Ill., has issued a new bulletin of 15 pages describing "Modern" meter housings, tops, simplified connections, concrete housing molds, and other products.

The Utah Corrugated Culvert & Flume Co. has issued a leaflet describing the Burnham submerged orifice for measuring the water delivered by irrigation canals.

The Lakewood Engineering Co., Cleveland, has published Bulletin No. 25, describing "Lakewood" trackless industrial haulage systems.

The Aetna Explosives Co., Inc., has issued a new booklet containing interesting information on fuse and electric blasting caps.